AUTOMOTIVE INDUSTRIES

Founded 1895

Vol. 76, No. 5

January 30, 1937

Flood Relief

General Motors officials and officers of the striking UAW agreed this week in Norwood, Ohio, on one subject—flood relief. By mutual agreement, the Fisher Body plant there was opened to build boats for use in flooded areas.

K. T. Keller, president of the Chrysler Corp., sent $10,000 to the American Red Cross for relief work in Evansville, Ind., when he learned of the extent of flood damages there. A large warehouse used by Chrysler now houses 350 refugees.

Emergency equipment, including 10 boats, 10 outboard motor boats, 250 pairs of rubber hip boots, 2000 ft. of rope, two Lincoln motor generators and a carload of groceries, was sent by the Ford Motor Co. to its organization in Louisville and Cincinnati for distribution in the flooded areas.

GM Makes Work for Idle

As Strike Deadlock Continues, Thousands Are Kept Off Relief Rolls by Part Time Work

Efforts of General Motors to provide work for as many as possible of its idle employees were meeting with considerable success this week.

Approximately 90 per cent of the total number of Chevrolet employes in Detroit, Flint, Saginaw, Bay City, Muncie and Indianapolis who were summoned to work, returned Wednesday at the reopening of the company's plants in those cities, said M. E. Coyle, general manager.

Fully 95 per cent of the night shift reported for duty. The shortness of notice was given as the principal reason why the small remaining percentage did not return to work, it was pointed out. It was further explained that many employes who were forced out of employment several weeks ago, through no fault of their own, had obtained jobs elsewhere, while others had left the community to visit friends or relatives.

No additional workers will be employed to take the places of those who did not report for work, Mr. Coyle said, as the company's purpose in opening the plants is to provide part time employment for as many regular employes as possible so that they will not be forced to go on relief.

Following is a list of the Chevrolet plants that were reopended Wednesday, with the number of workmen in each:

(*Turn to page 142, please*)

Congress Cautious

Cool Reception for Sec'y Perkins' Attempt to Hurry Legislation

Unless Secretary of Labor Perkins gets the open endorsement of President Roosevelt in her request to Congress for power to subpoena witnesses in connection with investigation of labor disputes, present indications are that the legislation will be blocked. This was disclosed Thursday by the chilling reaction her proposal encountered both in Congress and at the hands of John P. Frey, president of the

(*Turn to page 138, please*)

Car Sales Hold Steady

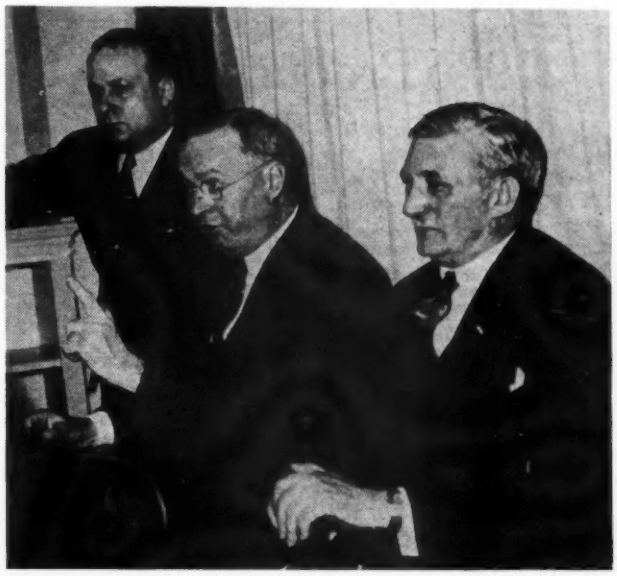
Only Temporary Curtailment Expected to Result from Floods

By Harold E. Gronseth

Automobile retail sales are coasting along on a level about 25 per cent under that of December, but with most companies showing substantial gains over January last year. Companies receiving weekly reports show little variation in the rate of sales for the first three weeks of the current month. Under normal conditions, a sizable increase in volume would be recorded in the final week, but with floods curtailing demand in certain sections and strikes preventing some manufacturers from supplying dealers with adequate stocks, deliveries in the final reporting period of January cannot escape being materially restricted.

More than 400,000 cars and trucks were sold at retail in the domestic market last month, although many of these vehicles were not included in the December registrations, but will appear in

(*Turn to page 138, please*)



John Thomas Smith, GM vice-president and general counsel, stresses a point in a Washington press conference. At the left is Felix Brunner, former Washington reporter who was added to GM's public relations staff since the strike began. William S. Knudsen (right), GM executive vice-president, has had a prominent part in efforts to end the strike.

Acme photo

White Fills Out Line

Three New Heavy-Duty Trucks, Including COE Model, Added

The addition of three new heavy-duty models to the White Motor Co.'s line has been announced by Robert F. Black, president.

Two of the new models are additions to the White 700 series—models 705 and 710—while the third adds another type to the Cab-over-Engine models, introduced last November at the truck shows. Powered by a White six-cylinder engine of 270 cu. in. displacement, the new model 705 offers a range of wheelbases from 136 in. to 214 in., and is listed in the 1½-2½-ton field. Developing 195 ft. lb. torque and 83 hp., the engine is built with patented "Pep" head combustion chambers which increase the nominal torque output and enhance fuel economy. A heavy counterweighted, heat-treated steel crankshaft is dynamically and statistically balanced and mounted in seven large bearings.

An exclusive feature of the engine is the White patented valves seating on the valve seat inserts which are watch threaded into the exhaust valve ports. A four-speed White transmission, with constant mesh helical gears in third and countershaft drive gears, is mounted as a unit with the engine. Full pressure lubrication is supplied by a gear type pump to all main, connecting rod, camshaft, piston pin bearings and timing gears through rifle-drilled passages.

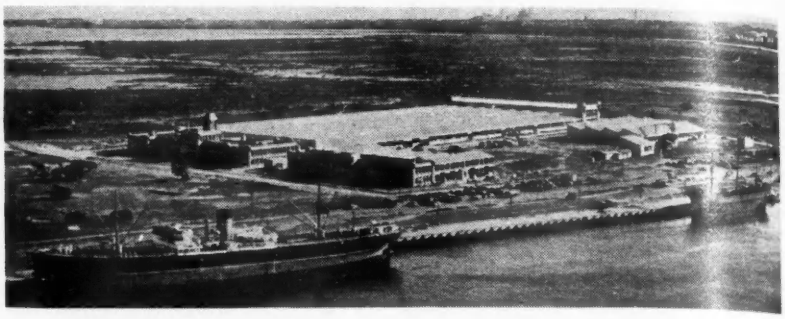
With four-wheel hydraulic brakes having 368 sq. in. of lining area, the new model 705 also is equipped with a White single reduction rear axle, full floating, having a housing cast in one piece. The spiral bevel, heat-treated alloy steel gears are mounted in a carrier which is dowel supported to the housing. Equipped with a cam and lever type steering gear to facilitate handling and parking, the model 705 provides further driver comfort with a positive air-ventilating system for the cabs and thickly-insulated floor boards permitting a fume-proof cab the year around.

Model 710 is powered by a White six-cylinder L-head type monobloc engine of 303 cu. in. displacement, developing 215 ft. lb. torque and 92 hp. The model offers a choice of six wheelbases ranging from 136 in. to 214 in. and is listed in the 2-4½-ton field.

The White model 710 heavy-duty truck is equipped with a single reduction, full floating rear axle of the banjo type cast in one piece; a White five-speed transmission mounted as a unit on the engine; four-wheel hydraulic brakes with 428 sq. in. of lining area; air-ventilated fume-proof cab; and a heavy counterweighted, heat-treated steel crankshaft, dynamically and statically balanced, and mounted in seven large bearings.

Offering a range of wheelbases from 97 in. to 193 in., the new White cab-over-engine model 810 is equipped with a White six-cylinder engine of 303 cu. in. displacement. Engine, radiator and transmission are removable as a unit at the front of this COE model, in common with all White models of this design. Listed in the 2-4½-ton field, this COE model has become a favorite because of the greater road stability which it offers.

The new models will be ready for delivery about the middle of February.



General Motors-Holden's new Australian plant at Melbourne, Victoria, which has a production capacity of 120 vehicles a day

Abrasion - Resistant Alloy Developed by Wilcox-Rich

Wilcox-Rich division of Eaton Mfg. Co., Detroit, Mich., has developed a new abrasion-resistant alloy, called "Xaloy," which is said to be quite revolutionary in its properties. The metal is applicable to cylindrical bodies and is applied by the centrifugal process of casting. It takes a high finish, has a very low coefficient of friction, and is extremely hard. The resistance to abrasion is such that parts coated with this metal have a life of from four to ten times that of materials previously used.

1936 Production Best Since 1929

Total Output Gained 12% Over 1935, Passenger Cars Being Up 12.2%, Trucks 10.5%

Passenger Car and Truck Production—U. S. and Canada

	December, 1936	November, 1936	December, 1935	Twelve Months, 1936	Twelve Months, 1935
Passenger Cars—U. S. and Canada					
Domestic Market—U. S.	398,581	315,523	322,096	3,458,068	3,041,877
Foreign Market—U. S.	27,438	25,933	20,926	217,995	210,367
Canada	16,542	10,086	10,666	131,308	135,562
Total	442,561	351,542	353,688	3,807,371	3,387,806
Trucks—U. S. and Canada:					
Domestic Market—U. S.	60,062	41,938	48,885	649,973	570,216
Foreign Market—U. S.	12,640	11,496	12,621	128,499	124,474
Canada	3,869	726	3,123	31,014	37,315
Total	76,571	54,160	64,629	809,486	732,005
Total—Domestic Market—U. S.	458,643	357,461	370,981	4,108,041	3,612,093
Total—Foreign Market—U. S.	40,078	37,429	33,547	346,494	334,841
Total—Canada	20,411	10,812	13,789	162,322	172,877
Total—Cars and Trucks—U. S. and Canada	519,132	405,702	418,317	4,616,857	4,119,811

:SLANTS:

TELL-TALE TIRES—*Tire imprints are now being used to solve crimes. Checking tire tread patterns against police files is only one feature of the new method of detection. The real science, as U. S. Rubber engineers point out, lies in the fact that no two tires wear exactly the same and therefore, never leave the same imprints. Tread wear is influenced by many factors such as temperature and weather, road surfaces and topography, inflation and loads, faulty brakes, misaligned wheels, etc. But the real irony, say the engineers, is that the driver himself plays such an important part in the wear, or lack of wear on his tires, that he is sure to leave a tell-tale clue. This driver element is what the police are now studying particularly.*

REFUELING—*Black subjects of an African potentate at Rei Buba, near the Cameroons, are happy if the jungle grapevine telegraph has brought them news of an expedition that recently left New York. Mr. and Mrs. Lawrence Copley Thaw, of New York, are bringing them relief. For the past 10 years the unhappy savages have been pulling their king around in his automobile. The car ran all right when it was given to him, but shortly afterward there was no more fuel, no more oil, and as the king had become quite fond of "motoring," man-power had to do the work. The Thaws are planning to cross Africa in six months from*

Algiers to Nairobi, using a special car and two light trucks to carry supplies. A large part of these will consist of gifts for the natives—including gasoline, lubricants and a new storage battery for H. M. the King of Rei Buba.

SAFETY LIGHTING—*Not content to safeguard the lives of its workmen in its plants alone, Chevrolet recently extended its efforts to Washington Avenue, a heavily-traveled four-lane highway notorious for its night fatality record, that passes the Chevrolet foundry at Saginaw, Mich. This road has represented a real hazard for the 3000 men employed in the foundry, particularly in winter when they arrive and leave the plant after dark. Approached by Chevrolet, the power company has installed lighting of the most modern type along the highway and the men are now able to traverse the road in relative safety.*

MOBILE WIRE OFFICES—*The telegraph has now come to the highway in the new Western Union telegraph offices located in trailers. This innovation follows the trend that is placing a growing proportion of the nation on wheels and in tourist and trailer camps. Telegraph trailers will be rushed to the scene of major news events, sporting and otherwise, which occur at a distance from regular offices, but where wire facilities can be made available. The trailers are distinctive in color with aluminum roofs and blue bodies.*

Automotive Payrolls Up in Canada

Figures just made public covering the payrolls of automotive plants in Canada show that this section of the Dominion's industries paid out $22,111,892.70 to employes during the year and that the average monthly employment for the period, 15,451 workers, was also up. For several seasons past, these totals have been steadily increasing.

GM to Pay $10,700,000 Savings

Distribution of 1931 Class Is Being Expedited to Ease Situation of Employees Now Idle

Distribution of $10,700,000 representing the 1931 Class of General Motors' Employes Savings and Investment Plan is to be expedited, it has been announced. Every effort will be made to distribute the fund as soon as possible, in view of the large number of the corporation's employes now out of work through no fault of their own.

The statement issued by Alfred P. Sloan, Jr., president, reads in part as follows:

"There will be distributed to General Motors employes a total of about $10,700,000. Of this, $4,200,000 represents an amount paid into the plan by the employes themselves. The balance, $6,500,000, represents the contribution made by the corporation.

"Each participant who paid $100 into the plan throughout 1931, now receives $256. Part of the disbursement will be made in cash and part in General Motors common stock. There are four more classes of the savings and investment plan yet to mature. Thirteen classes have already been completed.

"Since the inauguration of this plan of organized saving, a total of approximately $242,500,000 has been paid out to the corporation's employes. Of this, $103,000,000 represented the corporation's contribution, and $139,500,000 was paid in by the employes. With the 1935 class, the plan was discontinued in view of the Social Security Act."

Over 10% of German Trucks Now Have Diesel Engines

An official count has been made for the first time in Germany of Diesel-powered vehicles, showing that the total is greater than previously estimated. Of the 269,581 trucks in use in that country, 28,878 or 10.6 per cent, have Diesel engines. No truck over 2-tons capacity uses Diesels so that 35 per cent of the 82,793 trucks over this capacity are therefore Diesel-powered. Tank trucks are shown separately in the census and 76 of these have Diesel engines. There were 3291 units, or 25.2 per cent of the 15,567 buses in operation, powered by Diesels.

The total of 32,875 Diesel vehicles in use in Germany does not include 8957 tractors driven by Diesel engines and 10,941 tractors of a semi-Diesel type using hot-bulb engines.

Bendix Radio Formed

Will Specialize in Directional Compasses for Aircraft

Bendix Aviation Corp., through its president, Vincent Bendix, has announced the organization of the Bendix Radio Corp., a new concern which will take over four companies now operating in the aircraft radio field. The consolidated concern, Mr. Bendix said, will be the largest of its kind in the world.

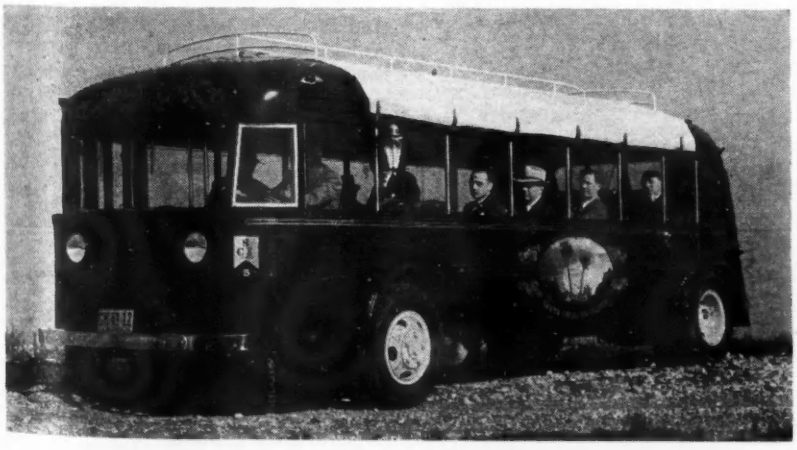
The companies involved in the consolidation are named as: The Radio Research Co., of Washington, D. C.; Radio Products Co., of Dayton, Ohio; and the William P. Hillyard Co. and Jenkins & Adair, Inc., of Chicago.

The new company, according to the announcement made by Mr. Bendix, will specialize in directional radio compasses for private and transport planes. It will be wholly owned by Bendix Aviation Corp., and Mr. Bendix will serve as its president.

Bendix Aviation Corp. heretofore has held a 50 per cent interest in Radio Research Co., and is understood to have increased this interest recently. It has also held a substantial control in the Jenkins & Adair and Radio Products companies. It acquired controlling interest in the Hillyard concern three months ago.

The company will devote all of its energies to the aircraft equipment field. It will not be concerned in any way with the household or automobile radio fields, according to advices given out by officials at South Bend. Its chief efforts at the present time will be given over to development of directional instruments, which officials at South Bend declare to be capable of receiving signals from three to five times more distant than the ordinary beam receiver. It is said, also, to practically eliminate the distorted night effect of ordinary direction signals.

The company will also manufacture a large number of communication accessories.



Visitors to the Island of Santa Catalina, Calif., are now able to tour the island in a modern bus designed along the lines of an old-fashioned stage coach. Built by the Twin Coach Co., unique features of the bus include a canvas top which, rolled up, allows passengers to view the mountain scenery; hand-stitched patent leather fenders and dash; authentic side carriage lamps; and scenic panels on the sides.

Glass Plants Resume

Automotive Supply Assured With Libbey Strike Settlement

The automotive industry was assured a free flow of safety glass early next week when the strike of Libby-Owens-Ford Glass Co. employes was settled at 4 p. m. Jan. 27. Workmen returned to the plants at Toledo, Shreveport, La., Charleston, W. Va., and Ottawa, Ill., but it was expected it would take from one to three weeks to get all operations going at peak.

The settlement was based on a wage compromise in which a flat increase of 8 cents an hour was granted to all employes but bonuses were based on the 1935 rates. The contract provides a minimum of 55 cents an hour for all women workers, 61 cents for window glass workers and 63 for plate and laminated employes. The new schedule brings Libby-Owens-Ford average wages to 89.8 cents per hour and the addition to the payroll will be $980,000 per year.

The union gave up virtually all its other demands including the closed shop, check-off of dues, preference to union members, vacations, Christmas and holiday bonuses, and increased production bonuses. It originally sought 10 cents an hour increase in wages.

Hours are continued on the 36-hour and 42-hour week with provision for a seven week peak automotive demand period in which a 48-hour week may be worked without overtime, all overtime is at the rate of time and a half.

By the contract, the union is recognized "as the collective bargaining agency for those employes of the company who are members thereof" in the various plants. Promotion is to be based on "department seniority and competence."

Under the present wage compromise a commission of five members is set up to study, together with a similar commission from the Pittsburgh Plate Glass Co., the wage differentials between the two large producers of plate and safety glass with a view to eliminating such differentials.

The new contract runs to Feb. 1, 1938. Ralph Lind, special Federal mediator, suggested the compromise on wages after a general agreement on all other issues had been reached last Friday.

David H. Goodwillie, executive vice-president, estimated the Toledo laminated plant will be in full operation by Monday and 2000 workmen will be back in the plate glass plant by Feb. 3.

Tire Plants Operating at Capacity to Build Stocks

Contrary to expectations, the larger Akron tire manufacturers furnishing the bulk of the primary tire market have not curtailed production drastically as a result of the automotive strike and the cancellation of practically all General Motors tire orders. Instead, they appear to be producing aggressively and building up inventories which are being shipped out of Akron and scattered to strategic points. The industry, it is learned, has two definite motives in continuing heavy schedules now in the face of reduced original equipment orders. One is to build up a further inventory cushion as a protective measure should the tire industry have a recurrence of last year's labor troubles. The second is the alarm over the crude rubber price trend which is steadily upward.

The industry's total stock position at the start of the year was approximately 20,000,000 tires in all hands. With original equipment orders slackened, this stock position probably will be increased by another 1,000,000 units during January.

Car Sales Hold Steady

(Continued from page 135)

the January figures, due to the usual lag between actual sales and titling. If the industry as a whole maintains the same ratio to December volume as shown by interim reports of some of the leading companies, aggregate January sales will be somewhere in the neighborhood of 300,000 units.

While the flood is likely to affect sales temporarily to some extent, manufacturers point out that a considerable part of the submerged area is not a heavy registration district. Although a few important markets are affected they account for a relatively small percentage of the entire domestic volume. Most of the business lost at this time, it is felt, represents only temporarily deferred sales. That was the experience last spring when sales in the inundated districts rebounded sharply after the floods subsided. The heavy losses sustained will, of course, keep some of the unfortunate victims out of the market for a time, but new business also develops from the disaster, such as increased replacements as a result of vehicles destroyed and requirements for reconstruction work. In addition, service business of dealers is stimulated.

Some curtailment in production has resulted from the flood. The Chrysler Evansville plant, which turned out 500 units a week, was forced to suspend operations. The Cincinnati and Louisville assembly plants of Ford Motor Co., with a combined daily output of 570 units, closed on Thursday last week.

Official figures released by the Department of Commerce show that December production of the industry in the U. S. and Canada reached a total of 519,132 units, compared with 405,702 in November and 418,317 in December, 1935. Despite holiday interruption, December output approached closely the year's peak of 527,726 units in April, which is the high mark since recovery began. The full year 1936 also went over the top, exceeding previous estimates with a total of 4,616,857 units, or a gain of more than 12 per cent over the 1935 total of 4,119,811 cars and trucks.

L. A. SHEA, formerly Chicago District manager of the Hevi Duty Electric Co., has joined the Lindberg Engineering Co., of Chicago, as assistant sales manager.

RALPH S. JENKINS has been appointed vice-president in charge of manufacturing of Gar Wood Industries, Inc., Detroit. Mr. Jenkins was formerly general manager of the St. Paul Hydraulic Hoist & Body Co.

KNOWLTON L. AMES, JR., has been appointed president of the Automatic Products Corp., according to an announcement by Vincent Bendix. Until last December, Mr. Ames was director of finance of the state of Illinois.

GEORGE C. FLEENER, formerly president of the Automatic Products Corp., is now vice-president and treasurer of the corporation, having relinquished the former position in order to give more attention to his other affairs.

W. S. DAWSON, formerly branch manager of the Tung-Sol Lamp Works, Inc., and associated for the past 20 years with the automotive trade, has been appointed general manager of the Cleveland Steel Products Corp.'s plant No. 2 at Wellington, Ohio.

FREDERICK C. HIMMELMAN, who was sales promotion manager of the Chrysler Sales Corp. for six years, has joined the staff of Brooke, Smith & French, Inc., Detroit and New York advertising agency.

VICTOR SHIPWAY has been appointed special representative of the Nash division of the Nash Kelvinator Corp. in the Far East. He has served with General Motors, Chrysler and Willys-Overland, both abroad and in their home offices.

J. HARRY GERKENS, for 27 years with Willys-Overland and since 1925 vice-president and treasurer, has resigned.

GM Gives $25,000 Flood Relief

Alfred P. Sloan, Jr., president of General Motors, from New York telegraphed, Jan. 26, to Admiral Cary T. Grayson, chairman of the American Red Cross, a subscription of $25,000 by General Motors to the Red Cross Special Flood Relief Fund.

"Congress Cautious"

(Continued from page 135)

Metals Trade Department of the American Federation of Labor.

Speaker Bankhead of the House of Representatives in a letter to Miss Perkins manifested a distinctly cool reception to the proposed legislation and told Miss Perkins that as yet he could not give her assurance of congressional action on her request for the legislation. Even Senator Norris of Nebraska, strongly pro-labor, while indicating sympathy toward the legislation said he would have to give it

study before approving it. Frey in a statement warned that it would be unfortunate if vesting the power of subpoena in the Secretary of Labor should in any manner interfere with or weaken the conciliation service of the Department of Labor.

The only open approval of the proposed legislation was given by majority leader Robinson of the Senate. Miss Perkins said she had received word from Robinson promising speedy consideration of her program. The program of Miss Perkins, it developed, not only proposes subpoena power for the Department of Labor but separate legislation which would greatly broaden the Wagner Labor Relations Act.

Going further, it would establish minimum wages, maximum hours and bar child labor, provide for collective bargaining and even for "improving general physical conditions of working places." She said this proposed program would be prepared by the "drafting department of Congress."

Miss Perkins declared that the episode of the General Motors strike has brought it clearly to everybody's mind that the Federal government ought to have more power in strikes. She said that she had not decided whether she would ask the President for his support in rushing through legislation giving her the power of subpoena.

She had asked the "utmost haste" in enacting such legislation. Speaker Bankhead, however, said that her proposal, which he characterized as "rather novel," will be given the consideration "that a communication of that kind justifies" and that "of course if a bill is introduced there will have to be hearings on it and it will have to take the usual legislative course." This statement of the Speaker of the House definitely indicated that the legislation, if introduced, will not be rushed as proposed by Miss Perkins. Senator Thomas of Utah expressed opposition to the Department of Labor being given subpoena power. He said if such power is given it should be under the jurisdiction of the National Labor Relations Board. Previously he had proposed that the Board be made a part of the Department of Labor.

Meanwhile, Miss Perkins announced that she had dispatched John Porter, attorney in the solicitor's office of the Department of Labor, to Anderson, Ind., to investigate an affidavit presented yesterday to the Senate Committee on Civil Liberties, by John L. Lewis, CIO chairman, charging that General Motors had incited violence against strikes in that town.

Miss Perkins said that General Motors officials in a telephone conversation had denied the charges made in the affidavit. She also said that she had communicated indirectly with Alfred P. Sloan, Jr., but declined to disclose what the nature of the communication was. She did not indicate any proposal might be under way for immediate settlement of the General Motors strike.

¾-Ton Truck Added

Hudson's "Big Boy" Models Fill Medium Capacity Needs

A new line of ¾-ton commercial cars, known as the "Big Boy" line and designed to serve in the wide field existing between present types of commercial cars and the larger trucks, is announced by Hudson Motor Car Co.

The new commercial cars in four models will be additions to Hudson's 1937 lines of Terraplane models which already include two lines of passenger cars and the Standard Six line of commercial cars, it was announced.

The "Big Boy" models will be presented on a 124-in. wheelbase as compared with the 117-in. wheelbase of the standard Terraplane commercial car models.

Continental Announces Two 4-Cyl. Industrial Engines

Continental Motors Corp. of Muskegon, Mich., has announced two new four-cylinder industrial Red Seal engines. These are Model Y69 2½ x 3½ four-cylinder, 69 cu. in. displacement, and Model Y91, 2⅞ x 3½ four-cylinder, 91 cu. in. displacement. Designed strictly for heavy duty industrial service, these units incorporate many features of Continental design, such as the fuel induction system which includes individual porting and is a major factor in economy.

General specifications cover all industrial requirements such as gear front end, mechanical governor, full pressure lubrication—crank and connecting rod bearings are interchangeable type thin-shell, steel-backed babbitt. Crankshafts are forged of high carbon steel and are carried on three large main bearings.

Ralph S. Jenkins,
recently appointed vice-president in charge of manufacturing of Gar Wood Industries, Inc.

Senate Scans Spy Data

Lafollette Committee Hears Charges of Chrysler, GM Activities

The Lafollette Civil Liberties Committee of the U. S. Senate extended its investigations this week to hear accusations against the General Motors Corp. and the Chrysler Corp. That the Flint Alliance, recently organized to combat GM strikes, would be investigated next week was indicated when subpoenas were issued against its organizer, George A. Boysen and a number of Flint municipal officials.

Accusations that the Chrysler Corp. had employed "undercover" men to report on its employes were made by Chester L. Robertson, general business representative for the Detroit Chapter of the Society of Designing Engineers, who said that the company had discriminated against those who joined the organization.

Allen P. Hascall, Chrysler purchasing agent, said that it was not uncommon for his company to employ men to investigate parts and materials suppliers. M. A. Wheeler, budget supervisor of the company, said that he had asked for an operative to get information on what the engineering society really stood for. James H. Smith, of Cleveland, president of the Corporation Auxiliary Co. which had been accused of labor espionage, identified his company as an "efficiency engineering" concern. Together with Dan G. Ross, general manager of the company, he denied that they were in the "espionage business."

Testimony showed that the Chrysler Corp. had paid $72,611 to the Auxiliary Co. for 1935 services. It was also brought out that the company had charged the Janesville, Wis., Fisher Body plant $100 a month to "educate" a Fisher employe to make "daily surveys" on plant conditions.

Glenn Martin Co. Spending $2,000,000 for Expansion

A plant expansion program to cost about $2,000,000 and to enable the company to build giant aircraft twice the size of the "China," "Hawaiian" and "Philippine" Clippers it designed and built, has been announced by the Glenn L. Martin Co., Baltimore. The expansion will double the company's capacity.

The new program provides that about $600,000 be spent for the latest machinery to increase efficiency in the production of aircraft. As a part of the addition to the factory, a 300 by 500 ft. assembly hall, with net overhead clearance of 40 ft., will be constructed.

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for AUTOMOTIVE INDUSTRIES

Floods are raging over large areas in several states, and injury to persons and damage to property are reaching alarming proportions. Business, of course, in the affected areas has been at a standstill. Some branches of business have been retarded by labor disturbances that have caused considerable apprehension. Nevertheless, business in general was favorable last week, with gains in the movement of goods at both retail and wholesale. The weekly business index compiled by the *Journal of Commerce* for last week stood at the preliminary figure of 96.1, as compared with 98.7 the week before and 81.5 for the corresponding period last year. The decline last week is attributed to the cessation of industrial operations due to strikes.

Business Index Rising

The business index of the Guaranty Trust Co. for December stands at the preliminary figure of 98.3, as compared with 92.3 the month before and 82.1 for December, 1935. The company's revised index of wholesale commodity prices on Jan. 15 stood at 84.1, as compared with 80.6 a month earlier and 69.5 a year ago.

Freight Shipments Higher

Railway freight loadings during the week ended Jan. 16 totaled 700,238 cars, which marks an increase of 1709 cars above those in the preceding week, a gain of 88,891 cars above those in the corresponding period last year, and a rise of 137,412 cars above those in the corresponding period in 1935.

Power Output Steady

Production of electricity by the electric light and power industry in the United States during the week ended Jan. 16 was moderately above that in the preceding week and 14.9 per cent above that in the corresponding period last year.

Chain Store Sales Up 19%

Sales of 27 store chains, including two mail order houses, during December were about 19 per cent above those in the corresponding month in 1935. Sales of these same companies during the entire year 1936 were almost 15 per cent above those in 1935.

Fisher's Index

Professor Fisher's index of wholesale commodity prices during the week ended Jan. 23 stood at 90.2, as compared with 90.7 the week before and 90.1 two weeks before.

Federal Reserve Statement

The consolidated statement of the Federal Reserve banks for the week ended Jan. 20 showed no changes in holdings of discounted bills, government securities and bills bought in the open market. Money in circulation declined $32,000,000, and the monetary gold stock increased $11,000,000.

France Offers Prizes for New-Formula Racing Cars

For the best speed performance on the Montlhéry circuit (Paris), not later than March 31, a prize of $19,000 is offered by the French National Committee for Automobile Racing. The main conditions are that the car must comply with the international racing formula to go into effect in 1938, that it must be of French construction, and that the average speed for a distance of 120 miles shall equal 91 m.p.h. A second competition, with a prize of $48,000, will take place under similar conditions from March to the end of August.

Under the new formula maximum piston displacement for a supercharged motor is 183 cu. in., or 274 cu. in. for a non-supercharged engine. In view of the difficulty of the track, the required average speed is high and has only been attained by supercharged motors of about 280 cu. in.

Three premiums of $950 each are offered for the best set of drawings of racing cars complying with the international formula. These premiums will be awarded at the end of June.

Probably only two cars will attempt to win the $19,000 prize. These are a Bugatti which has yet to be built and the Sefac designed by Engineer Emile Petit. This latter car has a dual four-cylinder motor, with the two crankshafts united by gearing, the piston displacement being 183 cu. in.

These prizes, totaling $69,850, became possible by the government grant of $48,000 toward the public subscription for French racing cars.

7-Year Financing, at 4½%, Arranged for Chicago Buses

The longest term for payments ever arranged for this type of purchase has just been approved by the Illinois Commerce Commission, which has authorized the Chicago Motor Coach Co. to buy 100 double-deck and 35 single-deck buses. Payments are to be spread over a period of seven years. The interest rate of four and one-half per cent is the lowest to date for this type of financing and compares with the six per cent formerly paid over a four-year period.

The new buses have been ordered from a General Motors subsidiary and involve an outlay of $2,227,166. The operating company's depreciation policy provides for the retirement of buses in seven years so that the new financing is spread over the estimated life of the vehicles.

GM Overseas Sales Up 15% in December

Sales of General Motors cars and trucks to dealers in the overseas markets during December totaled 30,045 units, representing an increase of 15.6 per cent over the volume in December of last year. For the full year 1936, sales totaled 324,758 units—an increase of 14.2 per cent over the volume of 284,281 in 1935.

These figures include the products of the corporation's American, Canadian, English and German factories sold outside of the United States and Canada.

Canadian Retail Financing Gains

A large increase in both amount of financing and number of motor vehicles financed in Canada during 1936, compared with the previous year, is shown in preliminary government figures just released. Motor vehicles financed totaled 134,862 at $54,209,000, compared with 100,178 at $40,342,264 in 1935. New vehicles financed numbered 42,560 at $29,726,841 in 1936 against 31,950 at $22,410,656, while used vehicles numbered 92,302 at $24,482,159 compared with 68,228 at $17,931,608 in 1935.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

Foreign Notes

Motor fire engines are to be tried in Paris. The power will be petroleum.

It is reported that a motion has been introduced in the Council of the City of Amsterdam, Holland, forbidding the use of motor vehicles in the streets of the city.

M. Jeantaud, the well-known carriage builder of Paris, is doing such a thriving business in the motor carriage line that other fashionable Parisian carriage builders are following suit.

M. Amédée Bollée used rubber belting in the motor carriage he constructed for the Paris-Marseilles race. No pump is employed to circulate the water for cooling the cylinders, the difference in density being said to accomplish this purpose very well.

Ludwig Lohner, of Jacob Lohner & Co., Vienna, Austria, who is introducing motor vehicles in that city, has issued a comparative table showing the economy of the motor over the horse in cost of operation. The first cost he estimates as about the same.

—From *The Horseless Age*, January, 1896.

Automotive Epitaph

By Berton Braley

*

Inside this vault
Is
William White
By whom
The laws were slighted
He always tried
To beat the light
And this
Is where he
Lighted.

*

Transport Commission Proposed for Canada

Legislation to extend the powers of the Canadian Board of Railway Commissioners will be introduced in the Senate at Ottawa, Ont., when it reconvenes Feb. 2. When the measure is taken up in the Senate, interested organizations will be given an opportunity to present their views before either the Senate railway committee, or its banking and commerce committee. Airmail rates, inland waterways tariffs and probably interprovincial highway traffic rates of buses and trucks will be placed in control of the board, it is believed. The board, it is said, may function as a Dominion transportation commission. At present it has control only over railways.

AMA Entertains Visiting Mexican Highway Officials

A group of visiting Mexican government officials was entertained at a luncheon in New York last week by the Automobile Manufacturers Association. The visitors were congratulated by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, on the completion within one year of the 700-mi. highway from Laredo to Mexico City. V. Cortes Herrera, Mexican Assistant Secretary of Communications, responded for the guests.

Speedy progress in the completion of the additional links of the Inter-American Highway which will eventually connect the U. S. with Panama City was predicted. The visitors made an inspection of New York City's highway facilities.

Chicago's Motor Salon To Be Held Feb. 13-21

The 14th annual Chicago Motor Salon, originally slated to begin Jan. 30, will be held Feb. 13 to 21 inclusive. Coming at approximately the same time as the old shows in the Coliseum, the Edgewater's Motor Salon has become increasingly important in recent years. In keeping with the current boom of the automobile industry, this year's North Side exhibition, like the show at International Amphitheater on the South Side last November, is expected to achieve new attendance and actual sales records.

Edwards Iron Works Files Reorganization Statement

A statement of assets of the Edwards Iron Works, Inc., which started the manufacture of trailer coaches and is now in reorganization in the United States District Court, is on file in the Federal Clerk's office, South Bend, showing total assets of $529,807.93 as of Nov. 30. Current assets, according to the trustees' report, were $257,735.63 and current liabilities, $187,713.04. Also included among liabilities are creditors' claims and rent amounting to $14,749.71, capital stock of $200,000 and surplus of $211,000.

Automotive Views Invited by Wellesley Summer Institute

The point of view of executives in the automotive industries is desired for the Summer Institute for Social Progress at Wellesley College where economic theories are squared with practical experience through discussions of present-day problems by men and women in the professional, business and industrial worlds. "The World Challenge to Democracy—How Can America Meet It" is to be the subject of the two weeks' institute for men and women to be held on the campus of Wellesley College, Wellesley, Mass., from July 10 to 24. Dr. Colston E. Warne of Amherst will be the leader. Those interested in the possibility of attending should write to G. L. Osgood, 14 West Elm Avenue, Wallaston, Mass.

Black and Crawford on 1937 Cleveland Exposition Board

Two Cleveland automotive executives have been elected to the committee which will manage the 1937 Great Lakes Exposition, opening in that city May 29. They are Robert F. Black, president of the White Motor Co. and F. C. Crawford, president of Thompson Products Inc. Mr. Crawford is also president of the National Air Races which will be held in Cleveland during the exposition.

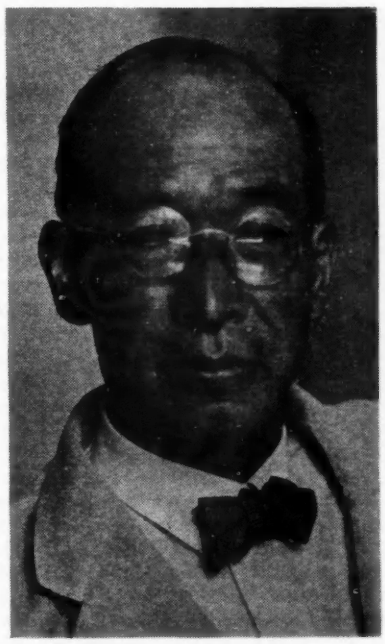
The interdependence of science, agriculture and industry will be dramatized under the theme, "The Making of a Nation," in this year's enlarged exposition.

West, Meet East!

Here Are the Men Behind Japan's Bid for a Place as an Automotive Manufacturing Nation

4. Risaburo Toyoda

There are so many Toyodas in and around the city of Nagoya that it is difficult to tell who is who. Ever since old Sakichi Toyoda set up shop some 50 years ago, the business has been run as a typical Japanese family enterprise, with a house constitution, annual supreme family councils and, occasionally, factional strife.



Risaburo Toyoda

The present Toyoda automobile concern is said to have resulted from one of these family dissensions that split the business into two sharply divided enterprises. The dispute was so grave, in fact, that the automobile Toyodas recently changed the company name to Toyota—with accent on the last "t."

Risaburo Toyoda—or should we say, "Toyota?"—is the eldest son of the eldest daughter of Sakichi Toyoda, famous inventor of automatic looms. He was born in March, 1884, and was graduated from the Tokyo Higher Commercial School. When the Nagoya faction of the Toyodas went into automobile assembly some years ago, the Kariya branch followed suit. Under the able management of Risaburo Toyoda, the motor vehicle business soon prospered, outstripping the Nagoya competition and eventually forcing it to close. Risaburo, raised in the traditional Toyoda environment of looms and spindles—55,000 are still under his management—seems to prefer, however, automobile manufacturing for which he sees a great future in Japan.

(This is one of a series of six brief biographies of Japanese automotive manufacturing executives.)

Acme photo

John L. Lewis (left) head of the Committee for Industrial Organization, states his position to Secretary of Labor Frances Perkins; Gov. Frank Murphy, of Michigan; and James F. Dewey, Federal conciliator.

GM Makes Work for Idle

(Continued from page 135)

Bay City parts plant, 2300; Saginaw foundry, 5350; Saginaw parts plant, 350; Saginaw transmission plant, 1800; Flint motor plant, 9000; Flint pressed metal plant, 4000; Detroit gear and axle, 9500; Detroit forge plant, 2500; Detroit spring & bumper, 1100; Muncie, Ind., transmission plant, 1500; Indianapolis commerical body plant, 1500; Anderson, Ind., Delco-Remy plant, 3700 (reopened Monday); total, 43,600.

Governor Murphy called strike leaders, National Guard commandants, Flint city officials and state police comissioner into conference to agree on a non-violence pact in connection with the GM back-to-work movement. The Governor declined the request of Flint officials for guards at non-strike plants, fearing the presence of troops would provoke trouble. Thus far both sides have adhered to the anti-violence agreement.

The governor's non-violence pact was made shortly before anti-strike forces, at a Flint mass meeting, called upon him to guarantee full protection to workers going to and from work.

Violence cropped out in Anderson, Ind., where civic leaders and non-union GM workers joined in a fight with fists and eggs against union members who attempted to hold a meeting. Three union leaders were jailed for their own protection, and were ordered to leave town.

Telegrams were sent to President Roosevelt and Governor Murphy "on behalf of 80 per cent of the Cadillac Motor Car Co. employes" expressing their satisfaction with general bargaining arrangements and working conditions existing prior to the strike and pleading for reopening of the plant.

Sloan Declines to Confer

Confronted with failure in her efforts to bring together in Washington General Motors executives and representatives of the United Automobile Workers Union, Secretary of Labor Frances Perkins in a letter to Congressional leaders Jan. 27 urged "the utmost haste compatible with sound procedure" in passing legislation that would give her the power to subpoena witnesses in conjunction with labor disputes.

Mr. Sloan on behalf of his associates and himself declined the invitation. In his letter to the Secretary, he said: "For the reasons stated on Wednesday and Thursday last, when in Washington at your request, confirmed by subsequent events, we sincerely regret to have to say that we must decline to negotiate further with the union while its representatives continue to hold our plants unlawfully. We cannot see our way clear, therefore, to accept your invitation. The only issue then, and now, is the evacuation of the unlawfully seized plants.

"The question of the evacuation of plants unlawfully held is not, in our view, an issue to be further negotiated," the letter continues. "We have steadfastly maintained, and again repeat, that we will bargain on the proposals set forth in the union's letter of Jan. 4, as soon as our plants are evacuated, and not before."

The position of General Motors was again made clear Wednesday by Mr. Sloan in a statement posted on the bulletin boards of GM domestic manufacturing plants. He pointed out to employes that during the three weeks since the strikes started, GM has earnestly striven to do everything possible to develop negotiations "with the group that has attacked us in the hopes of reaching a satisfactory solution that will protect the interests of all involved and enable you to go back to work." He said that the negotiations had broken down because of refusal of the union officials to withdraw the sitdown strikers despite the fact that over 100,000 employees have signified their desire to return to work. The leader of the union group, he pointed out, has publicly stated that hours, wages and conditions of employment are not involved. The issue involved, he added, is "That we should turn you over, body and soul, for exploitation." He assured them that General Motors will not "let you down."

To Create Jobs for 95,000

Returning to Detroit from conferences in Washington and New York, W. S. Knudsen, executive vice-president of General Motors, announced that the corporation would attempt at once to reopen partially plants that were closed indirectly by the strike. No attempt would be made, however, to resume operations in plants that are on strike.

"We have 95,000 out of work in addition to the 31,000 in struck plants," said Knudsen. "We may be able to give these 95,000 each a couple of days' work a week. It all depends on whether we can handle the stuff these people are going to make. You know an automobile takes a ton and a half of material and you have to have some place to put it."

Including office workers, the corporation still has 108,00 employes at work. About 70,000 of these are working on automobiles or automobile parts. Mr. Knudsen believed that "a fair number" of unemployed GM workers could be returned to their jobs. "I think we could rotate them," he said. An attempt will be made to give each individual a day or two of work a week. Present GM payroll, with 108,000 working, is about $756,000 a day. The 126,000 persons out of work normally would earn about $882,000 daily. Knudsen hopes to get the daily payroll up to approximately $1,100,000.

The reopening program will mean release of some orders to suppliers. "We are going to reopen any plant that is not on strike to the extent that is possible, as far as we can carry the inventory," Knudsen declared. "I think we can get some of the operations going in Chevrolet at Flint."

"Don't get the idea that this is a big strategic move of some sort, that we are trying to run around corners," Knudsen cautioned. "We are not. We are trying to get as many of our people some income as we possibly can." Reminded of the possibility of strikes in plants to be reopened, he said: "That is, of course, a risk we will have to run." Car production by GM now is "practically zero," Knudsen stated.

Property Rights the Issue

"The strike is an issue between property rights and no property rights," he asserted. "The minute the men leave the plants we will talk to them about anything. But as long as they are in our plants we won't do it, because we don't think it is right. We think anybody else in the United States would feel the same way about it. We have no intention of exercising our property rights except in a legal way. We feel that the issue is going to stand or fall on its merits, and we think we are right.

"Collective bargaining, such as has

been requested, is perfectly possible as soon as the strikers are out of the plants. We take no stand against collective bargaining with anyone representing the union."

Asked about proposals to poll the workers, Knudsen said: "I am in favor of anything to get things going. You haven't seen us try to sidestep any legal process in the whole question. If it is a vote on going back to work, we can have it at any time. But I think it is only fair that we know what is to be voted on and what the ground rules are before giving our approval."

Discussing the effect of the shutdowns on industry generally, Knudsen said: "Every automobile takes a ton and a half of material, and that is spread over practically every state in the Union. Consequently, when you take out of the picture eight or ten thousand cars a day, that is 15,000 tons of material that is not being used."

Ready to Reinstate Agreement

Knudsen said that the corporation stands ready to reinstate the agreement reached at Lansing and voided when strikers refused to leave the plants. "I am quite sure Governor Murphy understands that," he added. As to GM living up to its part of this bargain, he said: "I leave it to you to read the agreement and see if you can find anything we haven't done."

Asked whether GM would bargain with representatives of the Flint Alliance after bargaining with the UAW, Knudsen declared: "I think we would, unless in the bargaining the union became the exclusive bargaining agency —then there wouldn't be anything to bargain about. But the keynote of this ought to be that we want to go back to work—we ought to go back to work. There is no excuse for the present situation, no reason or logic in it."

Plans are under way in Lansing to push a bill through the legislature ordering a plebiscite of GM workers. Rep. John F. Hamilton said that if the resolutions committee considering the measure does not report it out Monday, he will use other measures to force a vote on it. This resolution, he explained, calls for a secret vote of all GM employes to be held under auspices of the state board of canvassers, a disinterested body, to determine if the employe favors the strike and what union he is affiliated with.

Homer Martin says the union has no interest in the plebiscite. "The strike itself is already a plebiscite. If the men were not in back of this strike they would desert the union or refuse to follow its leadership. The opposite is true. Men are joining the union every day and paying two dollars to do it. That is the best indication of what is wanted. We have a majority."

State Senator James A. Burns, Detroit, said he intends to introduce legislation in Michigan outlawing "this confiscation of private property by a minority. The minute a man quits his job, his contract of employment is at an end," he said. "When he remains in the plant he is a trespasser. Continuous trespassing is violence in itself. GM officials find themselves barred from their own plants by 15 per cent of their workmen. All who seek to enter the plants must obtain passes from the committee of strikers. Is this not confiscation of property? We find Gov. Frank Murphy promising food for the families of sitdown strikers, this food to be paid for by the people of Michigan. I will fight that move. The UAW is afraid to face a vote of Michigan's automobile workers to show its lack of strength."

Homer Martin said the plants of Ford Motor Co. and Chrysler could be tied up tomorrow if necessary. "There is no need of that," he added. "Chrysler has been bargaining with us since September. There is much to be said for Ford. Ford brought about settlement of strikes at Kelsey Hayes, Midland Steel and Briggs. He has led in increasing wages and he realizes workers should be better paid."

Latest GM strike was called by UAW at the Chevrolet and Fisher plants in Oakland, Cal., Monday. According to union officials, about half of the 2400 workers walked out, but plants continued operations.

Requests that the Alliance submit its lists to public scrutiny were granted and investigation begun by state police to determine relative strength of strikers and non-strikers.

The Workers Committee of Chevrolet Gear and Axle plant in Detroit, claiming to represent 10,000 workers, sent a telegram to John L. Lewis expressing bitter opposition to "your strong-arm methods, radical ideas, your open contempt and disregard for the laws of our country."

"The principles of minority rule which you have demonstrated at this time," the telegram continued, "do not appeal to our American standards of justice, and while so far we have tolerated it and voiced our disapproval through lawful and peaceful measures, we have arrived at the point where the families of the workers are beginning to feel actual privations, and are warning you that unless some effort on your part is made to settle this controversy, we will not be responsible for what may occur in the very near future."

The telegram closed with this sharp denunciation of Lewis: "In conclusion, you are a menace to the Constitution of the United States and its people. Therefore, we, the employes of the Chevrolet Gear and Axle, defy you and your malicious, un-American tactics. As law-abiding citizens, we will fight shoulder-to-shoulder with General Motors until your defeat is definitely determined."

Flint merchants report a 50 per cent drop in retail trade. City's welfare load has increased to 3500 families with 250 new applications for relief being received daily. Harvey J. Campbell, executive vice-president of the Detroit Board of Commerce said: "We just turned the corner around which prosperity was supposed to be—and ran right into John L. Lewis."

GM Protects Group Insurance

Acting to protect the group life insurance benefits of thousands of its employes who are idle because of strikes, the General Motors Corp. announced Wednesday that all coverage of such employes would be continued in force through payments advanced by the corporation. Strikers and non-strikers alike will be protected by the corporation's move.

Announcement of this plan was made by William S. Knudsen, executive vice-president of General Motors. For employes who desire to continue their insurance after returning to work, arrangements will be made for repayment of amounts advanced, it was said.

Group life insurance, carried by 219,974 General Motors employes in the United States and Canada totals $554,314,000. More than 98 per cent of the eligible employes are participating.

Acme photo

When GM officials held a nine-hour session with Secretary of Labor Frances Perkins and Gov. Frank Murphy in Washington—seated, left to right: Alfred P. Sloan, Jr., GM president; Secretary Perkins; Governor Murphy; and William S. Knudsen, GM executive vice-president. Standing, left to right: John Thomas Smith, GM general counsel and Donaldson Brown, GM finance committee chairman.

Automotive Metal Markets

Floods Have Cut Steel Output Five Per Cent; Automotive Shipments Steady Despite Strike "Hold" Orders

By William Crawford Hirsch

According to an estimate by the American Iron and Steel Institute, floods have impaired the country's steel output this week to the extent of about five per cent. No major shutdowns were reported, producers in the flood areas banking as a precautionary measure the more exposed of their furnaces. Finishing mill operations were virtually unaffected by the flood, but continued in many plants under restraint imposed by the General Motors strikes.

Shipments to automotive consumers whose operations have not been impeded and for stocking against the day of full resumption of normal activities continued to offset to a considerable extent the embargo caused by "hold" orders. That these are, however, still very much of an untoward influence in nearly all divisions of the steel industry may be seen from numerous complaints by wire manufacturers that their shipments to bolt makers have dipped sharply.

Flat steel producers report that their backlogs have increased as the result of the booking of sizable tonnages of strip and sheets at full first quarter prices. It is understood in the market that strike developments have eliminated Jan. 31 as the deadline for the shipment of lower-priced business, and shipments now under suspension because of the strike will be made whenever conditions permit, without penalty to the buyer. For some weeks to come, therefore, mills will be working up old business by the side of recently placed orders at higher prices.

Paucity in the yield of scrap iron of Michigan automotive plants plus continuously heavy shipments abroad from Eastern collection centers serve to hold scrap iron prices at abnormally high levels.

Pig Iron—Fresh business from automotive foundries is light, most of those now operating having covered their first quarter requirements previously. Here and there single carloads are called for, the new $21 price applying to all transactions. Much of the Lake furnace output is being piled in the hope of early opening of navigation and brisk demand for water-borne iron.

Aluminum—The market is quiet and firm.

Copper—Excitement in the foreign copper markets appears to have given way to more or less apathy. Consuming demand consists largely of producers' own fabricating needs, and domestic sales so far in January are reported to have been less than 50,000 tons. In the outside market, electrolytic is quoted at 12⅞ cents, the official producers' price continuing at 13 cents.

Tin—On reports that the flood would seriously impair operations of tin plate plants, the market yielded considerable ground at the beginning of the week, spot Straits selling at 50 cents, a full cent below the preceding week's close and the lowest price since Nov. 5. With the United States taking very close to one-half of the world's tin output, the market is naturally highly sensitive to developments here. News of strikes and floods in the United States created much bearish sentiment in London and Singapore.

Lead—Stocks of refined lead are shown by the latest statistics to be the lowest in three years. The market is quiet and steady.

Zinc—Unchanged.

A rather novel loose-leaf, spiral-bound handbook has been published by Continental Machine on its Doall method of **contour sawing and filing.** Here is a fast growing process of economically producing complex forms and contours with great ease. The handbook is provided with a thumb index which enables the reader to select various commonly-used methods with which this process is compared, as for example—shaper work, torch cutting, milling, etc.*

A small, solid, adjustable **die head,** manufactured by the Geometric Tool Co., New Haven, Conn., is described in a catalog just issued by that company.*

"House Trailer Red Book," a business directory of automobile house trailer builders, has just been published by Carrier Press, Chicago. The book contains data on more than 180 concerns, inc'uding names of executives and department heads, and information on the size of plant and volume of production. The price of the 40-page volume is $3.00 per copy.

A new edition of **"Lessons in Arc Welding"** has been issued by the Lincoln Electric Co., Cleveland, Ohio. Copies are mailed, postpaid, to any address in the United States for 50 cents each, 75 cents elsewhere.

A folder describing in considerab'e detail the properties of **beryllium copper alloys** has been issued by the Beryllium Corp. of Pennsylvania, Reading, Pa.

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia, Pa.

Government Takes Over Speedway

The race track at Montlhéry, France, has not proved a commercial success and there has been some talk to the effect that it would be abandoned. Now, however, what is known as the "automobile group" in the French Chamber of Deputies has proposed that it should be nationalized (the same as the aircraft industry) because it may prove of great use in testing out all of the various kinds of mobile equipment needed by the army.

Canadian Motor Transport Group

The Canadian Automotive Transportation Association has been formed in Winnipeg, Man., by representatives of trucking organizations in all Canadian provinces with the exception of New Brunswick and Prince Edward Island. The head office will be in Ottawa, Ont. The association despatched telegrams to the Dominion Government at Ottawa, asking to be represented on any board of transportation that may be set up by the Dominion.

Calendar of Coming Events

SHOWS

Automobile Show, Berlin, Germany, Feb. 20-March 7
Hungary, International Automobile, Motorcycle and Motor boat Exposition, Budapest .....March
Austria, Automobile and Motorcycle Salon, Vienna .....March 7-13
Switzerland, 14th International Exposition, Automobiles, Motorcycles and Bicycles, Geneva .....March 12-21
Portugal, 11th Automobile Salon, Porto March 27-April 5
Illinois Automotive Ass'n, 4th Annual Show and Maintenance Exhibit, Navy Pier, Chicago .....Apr. 24-28
Poland, Automobile Salon—16th International Fair, Poznan .....May 1-10
Norway, Automobile Salon—Oslo..May 7-10
Second Annual Automotive Maintenance Show, San Francisco..May 20-23
Belgium, First International Aeronautical Salon, Brussels ....June 18-30
Fourth ASTM Exhibit of Testing Apparatus and Related Equipment, New York .....June 28-July 2
Poland, Automobile Salon (Foire Orientale), Lwow .....Sept. 1-15
France, 31st International Automobile Salon, Paris .....Oct. 1-17
Great Britain, 31st International Automobile Exposition, London..Oct. 14-23
National Automobile Show, New York, Oct. 27-Nov. 3
Italy, 10th International Automobile Salon, Milan .....Oct. 28-Nov. 8
Great Britain, 13th International Commercial Automobile Exposition (trucks and buses), London..Nov. 4-13
Chicago Automobile Show.....Nov. 6-13
Great Britain, 36th Scottish International Automobile Exposition, Glasgow .....Nov. 12-20

CONVENTIONS AND MEETINGS

Tin Can Tourists' Winter Convention, Clearwater, Fla. .....Jan. 29-Feb. 8
Tin Can Tourists' Winter Convention, Sarasota, Fla. .....Feb. 8-14
Association of Highway Officials of No. Atlantic States, 13th Annual Convention, New York .....Feb. 24-26
American Society for Testing Materials, 1937 Regional Meeting and Committee Week, Palmer House, Chicago, March 1-5
International Association for Testing Materials, Second International Congress, London, England.April 19-24
41st Annual Convention and Exposition of the American Foundrymen s Association, Milwaukee .....May 3-7
American Society of Mechanical Engineers, spring convention, Detroit, May 17-21
American Petroleum Institute, Mid-Year Meeting, Colorado Springs, Colo. .....June 1-3
Second World Petroleum Congress, Paris, France ....late May—early June
Automotive Engine Rebuilders Association, 15th Annual Convention, Chicago .....June 21-24
American Society for Testing Materials, 40th Annual Meeting, New York, June 28-July 2

CONTESTS

Indianapolis Speedway, 500-Mile International Sweepstakes .....May 31
Pan American Cup Race, Roosevelt Raceway .....July 5
Roosevelt Raceway, 400-Mile George Vanderbilt Cup Sweepstakes... Sept. 6
Los Angeles, 500-Mile International Sweepstakes .....Nov. 28

Just Among Ourselves

What Does Right To Strike Imply?

AS the General Motors strike continues it becomes more and more apparent that the least of the issues involved (except, paradoxically, from the point of view of the corporation itself) is the welfare of the workers employed by the corporation.

American industry is unquestionably in a transition period so far as its labor relations are concerned, and the difficulty of being in the middle of such a period is that some of the old canons seem to have lost their force, without being replaced by new ones of promise.

Bound by the full force of corporate responsibility, General Motors has been proceeding according to the accepted rules of the game. The unions, and now, apparently, Government authority, have decided that the transitional nature of labor relations is sufficient license for making up the rules as we go along.

The right to strike, so long as it does not affect the public interest, so long as it does not result in violence and bloodshed, is not now seriously questioned by anyone. But under our existing Constitution and laws, the "right" to illegal occupancy has never been established, and we hope, in the interests of all of us it never will.

But Washington has seen fit to interpret, in one instance, the continued protest of General Motors against illegal occupation of its plants as a denial of the right of workers to strike. This is sophistry, and a relaxing of General Motors' position with respect to it would be unfortunate. Because the occupation of General Motors plants by workers is "peaceful" and because it is party of an admitted right to strike, does not remove the fact that the occupation itself is illegal.

Lack of Union Responsibility

MANY of the legal and other difficulties involved in the present situation arise out of the lack of corporate responsibility on the part of the unions. Several weeks ago we sat in on a meeting of Pennsylvania finance companies engaged in an earnest effort to formulate a code of ethics to guide their business. They did a pretty neat job on the code, and were all ready to go ahead with it, when someone pointed out that until the group was incorporated in legal form, the code was not binding and the group had no legal right to utter it. So it was decided to charter the group in order to give it the necessary legal status.

Unions in this country are bound by no such requirements. Without the responsibility of corporate status, they are able to bargain as a group, respond to elected leadership, and cause damage as a group without being held to account in the courts.

We understand that a well known heavyweight who is "in the money" has formed a personal holding company to conserve his assets. Suppose the next time he climbs into the ring with another fighter who just keeps his money in the bank—he gets a right to the jaw from the fellow who isn't in the money.

He comes back with a clean jab. Then the referee steps in and says: "You can't hit him, he ain't incorporated."

Such a situation would be no more anomalous than the one in which General Motors, being "in the money," finds itself.

Genuine Parts Compulsion Legal

AUTOMOBILE manufacturers have a legal right to compel dealers by contract to sell or use on repair work only "genuine" parts made or authorized by the factory, for use in that factory's cars. The effect of such contracts has not been substantially to lessen competition or to create a monopoly.

These principles were laid down clearly and forcibly by the U. S. Supreme Court in a recent decision (Pick Manufacturing Co. vs. General Motors Corp.).

Suit in equity against General Motors was brought by the Pick organization, with an attempt to establish violation of the Clayton Act. Specific mention was made of the Chevrolet Motor Company's dealer contract.

Most automobile companies have a "genuine parts" clause in their dealer contracts. Some companies police this provision more aggressively than others.

The present point of interest is that the Chevrolet contract has been through the fire in this respect without wilting. Maybe it would make a good standard for comparison when such questions come up.—H. H.

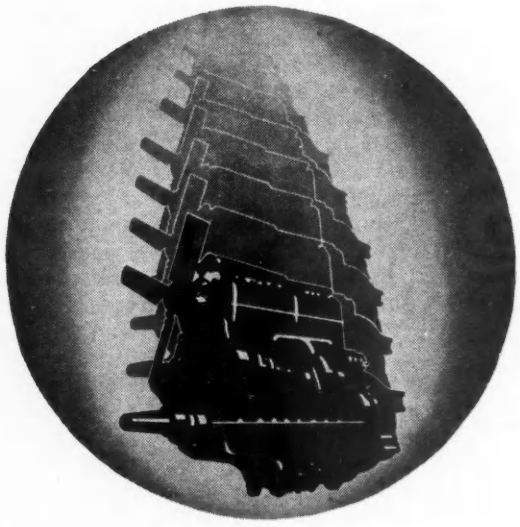
As Engine Development M

By P. M. Heldt*

IT is not very likely that during the next year or two there will be any pronounced move away from the present conventional chassis lay-out in American passenger-car practice, and whatever changes may be made in engine design during that period therefore will be such as to improve the present standard types. Present passenger-car engines on the whole show quite satisfactory performance, but it cannot be denied that they are susceptible to further improvement. Engineering efforts undoubtedly will be directed toward increasing the output per unit of displacement and per unit of weight, increasing the fuel economy, and increasing the service life. Engine development has proceeded along these same lines in the past, but as the specific output has increased, the obstacles to further progress have become more and more formidable. Results obtained from racing and aircraft engines indicate that if high specific output were the only object, designers of passenger-car engines would still have a long ways to go, but we must always remember that these engines must be very flexible, operate noiselessly throughout practically their whole speed range, must be economical to manufacture, and have a long service life.

As long as we adhere to the present general chassis lay-out the six- and eight-cylinder in-line and the eight- and twelve-cylinder V engines will no doubt retain their present relative positions, at least approximately. We know that within reasonable limits, as the size of the individual cylinder is decreased (so that for a given displacement the number of cylinders is increased), we are able to obtain a greater output per cubic inch of displacement, notwithstanding the fact that friction losses are greater in the engine with more cylinders. This is so because in the engine with the smaller cylinders, not only is the cross-sectional area of the inlet tract greater in proportion to the volume to be filled, so that induction can be accomplished in a shorter time, but at a given speed the inertia forces due to reciprocating parts are smaller in relation to the bearing areas on which they must be supported. On the other hand, the manufacturing cost increases with the number of cylinders, and besides, beyond six there is no improvement in the mechanical balance. The smoothness of the torque curve, of course, increases with the greater overlap of power impulses in the multi-cylinder engine, and while an increase in cylinder number probably is conducive to smoother idling, it has little effect on passenger comfort and on transmission stresses at average driving speeds, as long as the displacement of the engine is the same.

To increase the specific output of the engine we must increase either the brake mean effective pressure, the speed of revolution, or both. The b.m.e.p. can be increased by increasing the compression ratio, but in doing this we are likely to run into detonation trouble. Efforts therefore must be directed toward combating the tendency to detonation, and a good deal of work is actually being done along this line. Aside from the characteristics of the fuel used, detonation depends essentially on the form of the combustion chamber and the material of its walls, especially as regards its heat conductivity. Generally speaking, the higher the heat conductivity of the combustion chamber walls, the higher the compression ratio that can be used without risk of trouble from detonation. A high conductivity is especially desirable in those parts of the combustion chamber wall remote from the spark plug, where detonation takes place if it does occur. The adoption of aluminum cylinder heads has permitted of increasing the compression ratio. There is only one commercial metal which has a higher heat conductivity than aluminum, and that is copper. In the vicinity of the spark plug a wall material of high heat conductivity is a disadvantage, because it entails unnecessary heat loss. As long as there is combustible charge in contact with this portion of the combustion chamber wall there is no chance of self-ignition under normal operating conditions. However, the temperature of the unburned portion of the charge increases rapidly during the combustion process, and unless the cylinder wall with which the last part of the charge to burn is in contact is maintained at a fairly low temperature, spontaneous ignition of the whole of the remaining charge is likely to occur, which means detonation. Theoretical conditions therefore point toward the use of composite cylinder heads, with walls of low heat conductivity near the spark plug and walls of high heat conductivity remote from the spark plug. But it is obvious that the



*Presented as a paper at the Annual SAE Meeting in Detroit.

Moves Forward—

Engineering efforts will be directed toward fuel economy and increasing the output per unit of displacement

Part One

The second and final instalment will appear in an early issue

problem of manufacturing a composite cylinder head, of materials having different heat conductivities and different coefficients of thermal expansion, which will stand up under the conditions of alternate heating and cooling and repetitive shock load, is not an easy one. If the problem of a bond that will endure under these conditions can be satisfactorily solved, from both the technical and the commercial standpoints, then composite cylinder heads may pave the way toward still higher compression ratios and higher specific outputs.

The point has been made in this connection that better heat conductivity of the combustion chamber walls would not be an advantage when idling, as the spark plugs would be likely to run so cool that they would become fouled in short order. The tendency of the plugs to foul is not likely to be increased by composite cylinder heads, as that part of the head in the vicinity of the spark plugs would be made of material of low heat conductivity. It must be admitted, however, that combustion chamber walls of high heat conductivity are of advantage only as long as the engine is running under full or nearly full throttle; as soon as the throttle is sufficiently closed so that the danger of detonation has passed, any additional heat loss through the walls is detrimental. The point illustrates the difficulty of the problem arising from the requirement that engines shall operate smoothly under full throttle and also fire regularly under nearly closed throttle when idling at a few hundred r.p.m.

Detonation is also affected by the shape of the combustion chamber, a subject that has been discussed in numerous previous papers by authors who have done original work along this line. The most important requirement seems to be that in the part of the combustion chamber remote from the spark plug, where the flame front arrives last, the piston head come close to the cylinder head at the end of the stroke. There is then relatively little combustible charge between these surfaces, and the heat generated in this charge by its compression, resulting from expansion of the burning portion of the charge, can flow off readily to the adjacent walls, so that no excessive temperature rise can occur. These principles have now been known to engine designers for so long that the combustion heads of most current engines are well shaped from the anti-detonation standpoint, and little further progress seems likely in that direction.

Improved Fuels

The anti-detonating characteristics of the fuel used are really the most important of the factors determining the highest useful compression ratio, and further increase in the octane value of commercial fuels would permit of increasing the compression and hence the specific output. In experimental work the compression ratio in spark-ignition engines has been carried as high as 10 to 1, but in these experiments gasoline of 100 octane number with a supernormal proportion of ethyl fluid was used, and such fuels, of course, are far from being commercial for general passenger-car use. Nevertheless, increase in the anti-knock value of commercial fuels is likely to continue during the next few years, as octane rating is really the principal basis of competition between fuel refiners.

There may be some further gain also in the volumetric efficiency, which would further increase the b.m.e.p. and the specific output. This would necessitate enlarging the effective cross-sectional areas of the induction system and cooling the ingoing charge more effectively. In the past, the size of inlet passages has been restricted by considerations of smooth idling. If the passages are too large, the air velocity at idling is too low and the air cannot hold the entrained fuel in suspension, which leads to unequal distribution and missing. The downdraft carburetor has in part solved this problem, as the fuel particles need no longer be lifted by air friction against the force of gravity. On many racing engines multiple carburetors are used so as to eliminate the distribution problem partly or completely, and all eight-cylinder engines are currently equipped with dual carburetors for the same reason. Another solution now in course of development is to use two complete induction systems of which one is in service all the time while the other comes into action only at high speeds, when both operate in parallel. This is on an engine with a special type of valve gear and the system may not be applicable to poppet-valve engines. We may also see more extensive use of the plan of taking the air for the carburetor from outside the engine space, where under severe operating conditions the temperature is likely to be nearly 100 deg. F. lower.

In the past much greater gains in specific output have resulted from increasing the rotative speed than from increasing the b.m.e.p., and it is to be expected that the first factor will continue to rise more rapidly than the last mentioned. The earliest automotive engines turned over at about 600 r.p.m., while at present 4000 is considered a normal speed, so that speeds have in-

creased in the ratio of 1 to nearly 7. During the same period the b.m.e.p. at maximum power has increased only from about 60 to about 90 lb. per sq. in. Higher speeds, of course, necessitate larger or freer induction systems and lighter reciprocating parts. The chief difficulty that we usually run into in endeavoring to increase the operating speed is roughness in operation and trouble from torsional vibration. Experience with high-speed engines has brought home to us the fact that all materials used in engine construction are elastic and all engine parts therefore are capable of free vibration. The pressure impulses created by the gaseous explosion and the inertia impulses due to the reciprocating motion tend to induce vibrations, and the nature of the materials and the forms of the parts determine the frequencies of natural vibration of the parts. Serious vibration can occur only if the frequency of the impulses or of one of their harmonics is substantially equal to the frequency of free vibration of the part. If we raise the speed of the engine we increase the frequency of the impulses and of the harmonics thereof, and to prevent increased trouble from roughness of operation, we must at the same time increase the stiffness of the engine structure so as to increase its natural frequencies of vibration correspondingly. The stiffness of the crankshaft also must be increased so as to raise the natural frequency of torsional vibration. In fact, the primary requirement in ultra high-speed engines is rigidity, not strength. This must not be forgotten when contemplating a change from one material to another. All steels, of course, have substantially the same modulus of rigidity. Ordinary cast iron has only about one-half the modulus of rigidity of steel and will deflect twice as much under a given load as a steel member of the same dimensions. Therefore, if a steel member is replaced by one of cast iron, either the section must be increased or the length between supports (if the member is subjected to bending loads) reduced. This point must not be overlooked when considering the use of cast material for crankshafts and camshafts. It appears that any material which can be successfully cast has a modulus of rigidity substantially lower than the 30,000,000 shown by the average forged steel. As the modulus of rigidity is reduced, the deflection under a given impulse increases, so that in cases of resonant vibration the amplitude of vibration will be greater with the material of lower modulus of rigidity. The hysteresis factor of the material also has an influence on the maximum amplitude of vibration. Of course, response to vibrating forces is only one of the items that must be considered in connection with the choice of suitable materials, but it is obvious from the foregoing that for crankshafts of long engines especially, materials with a low modulus of rigidity are at a disadvantage.

The principal vibrating members of high-speed engines are evidently the engine block or crankcase (roughness) and the crank assembly (torsional vibration). The vibration designated as "roughness" is participated in by both the crankcase and the crankshaft. One method of combating roughness and raising the practical limit of rotative speeds therefore consists in stiffening all parts subjected to periodic forces or moments. This should be accomplished as far as possible without adding to the material used, largely for economic reasons.

Combustion-Chamber Form

While vibration and roughness can be held down by stiffening of members, the problem can be attacked also by reducing the amplitudes of the vibrating forces. The forces which are the principal direct causes of roughness and other forms of vibration are the harmonics of the gas-pressure cycle. The greater the amplitudes of these harmonics the more severe will be the roughness induced by them, and the amplitudes of at least the first few harmonics depend very much on the rate of pressure rise. Therefore, in order to keep down the roughness, the maximum rate of gas pressure rise must be kept down. The rate of gas pressure rise is roughly proportional to the area of the flame front. With the flame front at a distance a from the spark points (where combustion originates), the area of the flame front is the area of that part of a spherical surface of radius a, around the spark points, which is located within the confines of the combustion chamber. It has been pointed out already that to prevent detonation, that portion of the combustion chamber in which combustion terminates must be very shallow, and this means that toward the end of combustion the flame front area is small and the rate of pressure rise therefore low. During the earlier part of the combustion, while the flame front is still close to the spark points, its area cannot be very large, but after it has traversed from 10 to 15 per cent of its total path, it should be held substantially constant for some 20 or 30 per cent of the total travel, so that the flame front area and the rate of pressure rise may at no point become excessive. In other words, there should be no sharp peak at this part of the curve of flame-front area. Thereafter the area must decrease in order to meet antidetonation requirements. One authority has stated that if the flame-front area at 20 per cent of maximum flame travel is greater than at 40 per cent, the engine will be smooth in operation. However, as smoothness depends not only on the characteristics of the vibration-inducing force (represented by the gas pressure curve) but also on the rigidity of the vibrating structure, it does not seem logical to try to establish so rigid a relationship between the gas pressure curve and engine operating characteristics. As long as the engine structure remains the same, the gas pressure curve is the only variable and a definite relationship then exists between it and the smoothness of operation.

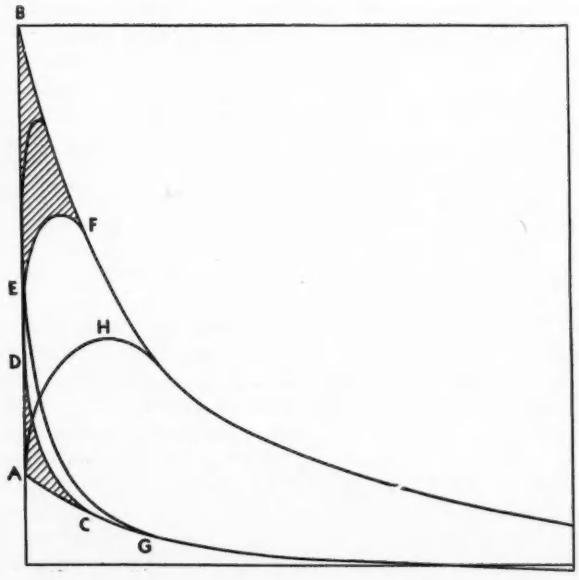


Figure 1

Showing effect in change in spark timing on shape of pressure - volume cylinder diagram

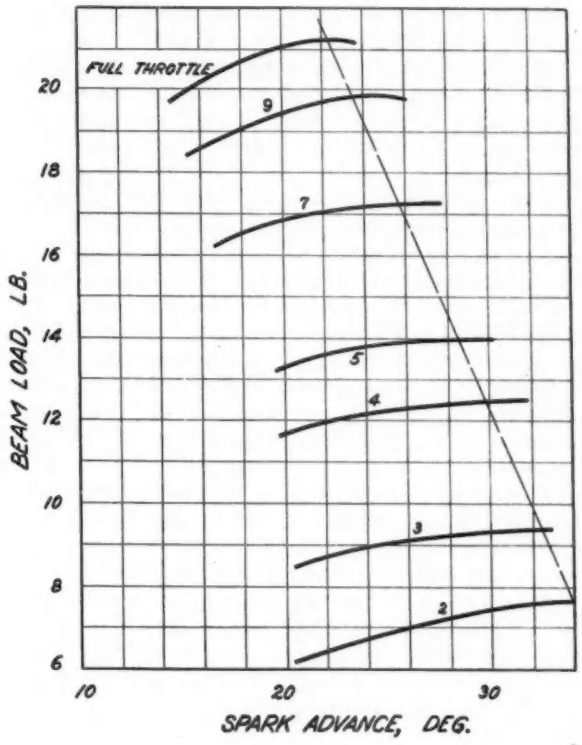
During the past year considerable emphasis has been placed on fuel economy, by discussions of the 30-mile-per-gallon car, by various fuel-economy trials or demonstrations, and by interest shown in overdrives. The fuel mileage of a car, of course, depends only partly on the powerplant, but if it is to be materially improved, every one of the factors entering into it must receive serious consideration. The thermal efficiency of the engine, the same as the specific output, depends upon the compression ratio, and this factor has been discussed already from the standpoint of its effect on specific output. It is not likely that much can be gained in the way of fuel efficiency by a further increase in compression ratios, as that entails an increase in combustion pressures and in internal friction.

Greater possibilities seem to be offered by the use of the leanest practical mixtures, and a solution of the problem of uniform distribution. It is generally known that the most economical mixture has a weight proportion of about 16:1 while the maximum power mixture has a proportion of about 12:1. Carburetors at present are generally adjusted for a mixture approaching the maximum power ratio. One reason for this is that it gives slightly more power than the leaner mixture and another that it assures more reliable ignition when the engine is cold, under which condition not all of the fuel may vaporize, so that the effective strength of the gaseous mixture is less than would be concluded from the proportions of air and fuel supplied to the engine. The weaker mixtures are hard to ignite, especially with the conventional short spark gaps and when the combustible mixture is contaminated with considerable proportions of spent gas.

It is therefore more than likely that widths of spark plug gaps will be increased during the next few years, as with these longer gaps materially leaner mixtures can be ignited satisfactorily. The reason these longer gaps are not being used now is that they call for higher spark voltages, which conventional spark coils are unable to supply, particularly when the voltage applied to the coil is nearly cut in half by the heavy battery current required for starting a cold engine. Experiments with one particular engine have shown that the fuel mileage can be increased some 5 miles per gallon by the simple expedient of leaning out the mixture and suitably increasing the gap length and the spark voltage to assure positive ignition of this leaner mixture. Supplying the higher spark voltages should not be a difficult problem, although it will call for somewhat larger coils. The greater effectiveness of the longer spark is readily explained, as with the same current (determined by the capacity of the condenser) and a considerably higher voltage, the spark has a greater heat value, while with the greater length of the gap it is also more likely to have ignitable mixture in its proximity.

Figure 2

Variation of engine torque with spark timing for various throttle positions



A few words regarding the subject of spark timing in accordance with torque load or its related variable, the the inlet-manifold pressure, may be apropos here. This feature has found rather wide application in recent years, but some manufacturers have abandoned it again. I want to first discuss the subject briefly from the theoretical standpoint.

The need for variable spark timing arises from the fact that explosive mixtures of gasoline and air do not burn instantaneously but require a definite time for their combustion. The conversion of heat into mechanical energy in the cylinder would be most efficient if the charge were compressed up to the end of the stroke, to point *A*, Fig. 1, and all of the heat of the fuel were then released instantaneously, which would result in an instant rise in pressure represented by the straight line *AB*. Then, as the piston proceeded on its down stroke, there would be a rapid drop in pressure. This condition of operation would result in both maximum power and maximum fuel economy.

As the combustion of fuel takes time, if ignition occurred only when the piston had reached the end of the stroke, the cylinder pressure would rise only very gradually, as indicated by the curved line *AH*, and as a result, all of that part of the work of the cycle represented by the area of the diagram above line *AH* would be lost. To reduce this loss, ignition must be effected ahead of dead center, as, for instance, at point *C*. Combustion then begins at this point, and the pressure in the cylinder begins to rise above the compression line. Since the piston is now moving against the cylinder pressure, any increase in the pressure during this part of the cycle results in a loss of power. This loss is represented in the diagram by the shaded area *CAD*. There is a gain in power, however, as a result of the earlier completion of combustion. At any point in the early part of the power stroke, more fuel has been burned than when ignition occurred in dead center, and the cylinder pressure is therefore higher. The pressure varies as shown by the line *DEF* and the area included between line *AH* and line *DEF* represents the gain in power.

Load-Control of Spark Advance

As here represented, the loss due to early ignition (the shaded area *CAD*) is much smaller than the gain due to earlier completion of the combustion represented by the area between lines *AH* and *ADEF*. A further increase in the ignition advance is therefore ad-

visable. By letting ignition occur at point *G* the loss due to advanced ignition is considerably increased, but the gain due to earlier completion of the combustion is also increased, because the maximum pressure reached is now much greater and, besides, it occurs earlier in the power stroke. Evidently, the optimum ignition advance is that for which any slight increase in the loss due to ignition advance is exactly equalled by the gain due to earlier completion of the combustion.

The foregoing, of course, holds true whether the engine runs under full throttle or under part throttle. But when running under part throttle the compression pressure is less, and the rate of flame propagation is lower in the less dense mixture. It, therefore, takes longer for the flame to travel from the spark points to the most remote portion of the combustion chamber, which is to say that combustion takes longer. To compensate for this slower combustion, the spark must be set earlier—the earlier the smaller the load. At small loads, moreover, there is no danger of detonation, and the spark therefore can be advanced as much as required by considerations of economy. This advance of the spark with decrease in load is effected by having the vacuum inlet manifold act on a diaphragm which is connected to the timing lever. Evidently, for full-throttle operation the spark setting must be the same whether the timing is controlled by the load or not; with load control the spark is advanced automatically as the load decreases. As there is a difference in the timing only at part load, the gain in economy is limited to part-load conditions and the relative improvement should be the greater the smaller the load.

Some experimental data corroborating the above theoretical discussion have been furnished me by Mr. Rabezzana of the A. C. Spark Plug Co. In Fig. 2 are plotted some test data from a single-cylinder test engine running at 1000 r.p.m. Each of the several curves represents the maximum beam load the engine would carry for any particular setting of the throttle valve, as a function of the spark advance. The straight inclined line at the right passes through the points of maximum output for the different throttle settings, and is therefore a line of optimum spark advance. This plainly shows that as the load decreases the optimum spark advance increases. Without load control for the spark advance the spark would have to be set in the position of optimum advance for full load, and it will be seen from this that if it were then in the minimum throttle position (2) the engine would only be able to pull a beam load of 6½ lb., instead of more than 7½ lb. with the optimum spark advance for this load. The gain in power over a wide range of throttle opening due to load control of the spark timing is shown graphically in Fig. 3, which is merely a replot of the data represented in Fig. 2. If, for instance, the operating conditions are such that the engine has to develop torque corresponding to a beam load of 8 lb. (represented by point *A* on the curve for spark advance independent of load), the fuel-consumption rate is shown by point *A'*. If, on the contrary, the spark is advanced in proportion as the load decreases, then a beam load of 8 lb. can be pulled with a throttle opening represented by point *B*, which corresponds to a rate of fuel consumption represented by the point *B'* on the fuel consumption curve. Thus there is a saving in fuel represented by the vertical distance between points *A'* and *B'*, in this particular case 1 lb. per hour.

Mr. Rabezzana points out that the gain is generally smaller in the case of multi-cylinder engines. Fig. 4 is a plot of rate of fuel consumption at constant road load vs. spark advance at three speeds for an eight-cylinder 1936 car. The reduction in fuel consumption between points *A* and *B* (full-load spark advance and optimum part-load spark advance) varies between 2 and 5 per cent.

With the trend toward still higher rotary speeds, there will undoubtedly come a further reduction in the stroke/bore ratio, which at present averages about 1.35. In the case of L-head engines this tendency conflicts with that toward higher compression ratios, as with very short strokes it is impossible to bring down the compression volume to that required with a compression ratio of 6.5 or 7. With valve-in-head engines this limitation does not exist, and stroke/bore ratios in that type may come down to unity and even less.

Engineers recognized long ago that for gasoline engines there is no inherent merit in proportionately long strokes, as at one time believed, and in aircraft engines, where maximum specific output is of paramount importance, the stroke/bore ratio is usually held close to unity. One advantage of the shorter stroke is that it permits of greater valve capacity in proportion to cylinder volume, thus rendering a higher operating speed possible from the charging standpoint. It also makes it easier to assure rigidity of parts susceptible to vibration for a given amount of material. Of course, with in-line engines, the short-stroke design does not work in so well with present-day general car forms. Hoods have to be of a certain height for the sake of appearance, and as crank centers must be low for the sake of stability, there is plenty of height under the hood for engines of relatively long stroke; on the other hand, an eight-in-line engine is quite long in any case, and occupies a large part of the frame length, and if the stroke is reduced the bore will have to be in-

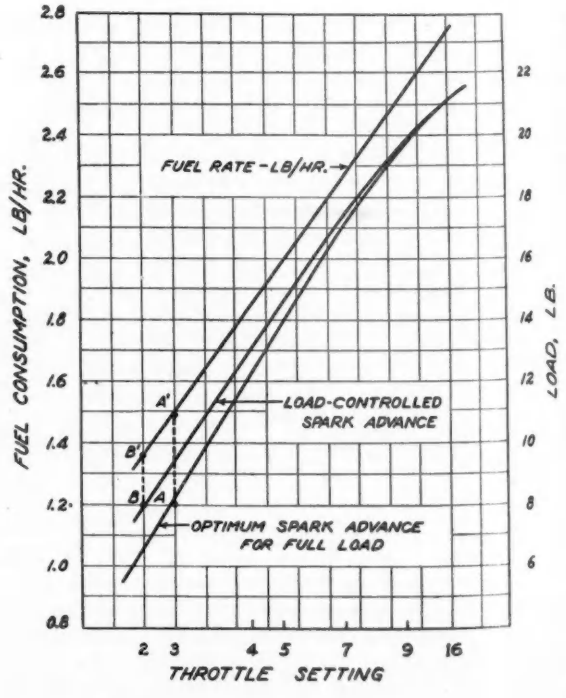


Figure 3

Variation of fuel consumption with throttle position for spark advance controlled by load and independent of load

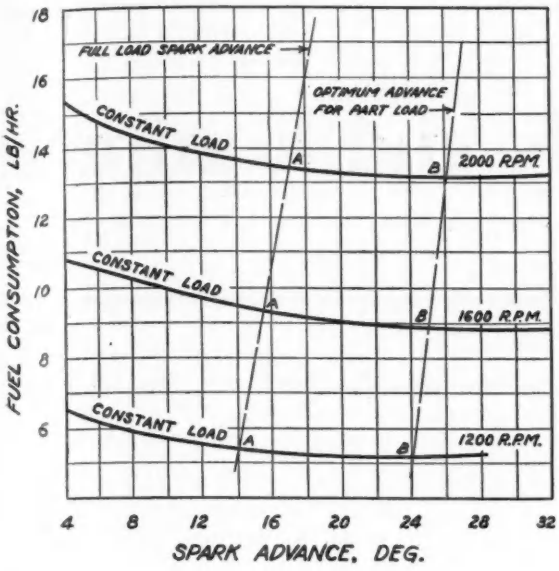


Figure 4

Variation of hourly fuel consumption with spark advance at constant torque and three different speeds

creased to make up for the loss in displacement; this adds to the length, which is already a handicap of this type of engine. Therefore, the short stroke is likely to appeal most to designers of V-type and especially flat or horizontal-opposed engines.

Another development that tends in the direction of higher fuel economy is that of fuel injection, but whether this will reach the state of commercial practicability for the general run of passenger cars during the next few years is doubtful. It has been pretty well established that by injecting fuel directly into the cylinders, the horsepower can be increased and the fuel consumption reduced, but whether the cost of the necessary equipment can be brought down sufficiently low is another question. The equipment required is similar to that used with Diesel engines, which alone costs about as much as a complete quantity-built carburetor engine. Moreover, except for the much lower pressures of injection, the technical problems involved in injection equipment for gasoline are more difficult than those of similar equipment for fuel oil, as the gasoline is much more fluid and therefore harder to retain, and it also has no lubricating value.

An increase in the rotary speed of the engines will bring with it numerous detail problems. For an engine of given cylinder dimensions it means that we burn fuel at a rate increased in about the same proportion as the speed, and all parts therefore will work at higher temperatures. This can be counteracted in part by the provision of more liberal water jackets and more rapid circulation of the cooling water. Such features as full-length water jackets and jet-cooling of exhaust valve pockets, introduced in recent years, are bound to become more common. New types of cylinder head, made in whole or in part of materials of high heat conductivity, are likely to come into use. The problem of the most advantageous point of water introduction will be given further study.

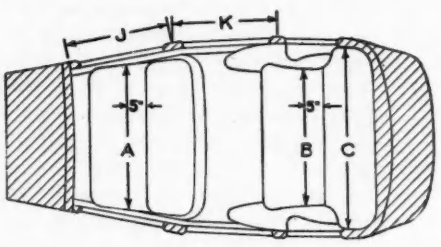
Among the working parts that suffer most under an increase in the temperature of operation are the valves and their seats. Recently, owing to the increase in the specific output and the consequent rise in operating temperature, the steels which had been used satisfactorily for exhaust valves for a long period of years had become inadequate, but new, improved steels have been introduced and will undoubtedly meet requirements for some years to come at least. Beyond these the designer has the choice of resorting to the use of hard alloys which are applied to valve heads and valve-seat inserts in the form of a light veneer. These improved valve materials are needed to keep down the rate of valve seat wear, thereby keeping up the mileages between valve-tappet adjustments and valve regrindings. As with other items of engine design, practice in this respect will be guided by the advantages secured from the use of the improved materials and by the higher cost of their use.

With further increase in engine speed and specific output, more attention will have to be given to service life and to oil economy. Cylinder wear is conveniently expressed in car miles per 0.001-in. wear. Some of the low-powered European cars get only about 1000 miles per 0.001-in. cylinder wear, and wear figures published for one particular Continental small car show an average of 1700 miles per 0.001-in. cylinder wear. Tests made on American-car engines have shown wear figures ranging from 1670 to 3600 miles per 0.001-in. cylinder wear.

It has been shown that corrosion is a large factor in cylinder wear, and corrosion can occur only while the engine is still sufficiently cold so that the water vapor in the gases of combustion can condense on the cylinder walls. Therefore, any equipment which causes the cylinders to heat more rapidly when the engine is being started from cold tends to reduce the rate of wear. Among such devices are thermostatic valves for circulation control. Anything which reduces the cooling effect when the engine is cold is evidently of advantage from this point of view. Inventors in recent years have devoted much attention to means for disengaging the fan drive when the engine is cold, which not only accelerates the temperature rise under such conditions but also saves the power which is being unnecessarily expended in driving the fan. But so far no really practical device seems to have been developed.

In engines with pressure lubrication the lag in the supply of lubricant to the cylinder walls when the engine is being started from cold evidently also has a detrimental effect on cylinder wear. It can be overcome by providing direct feed of lubricant to the cylinder walls while the engine is cold. One method of controlling this direct feed would be by interconnecting the control valve with the starter switch, but as this would turn on the direct supply whenever the engine is being started, whether it is cold or not, this method would not entirely meet the requirements. Thermostatic control should prove more rational.

While lubrication must be improved to keep down the rate of cylinder wear, the consumption of lubricant must be kept down. Oil consumption increases rapidly with the speed of the engine, and it is the consumption at the upper end of the speed range which must be particularly watched. Oil control rings are depended upon to hold down the consumption, and although they are efficient while new, many of them do not seem to retain their oil-control characteristics very long, as evidenced by the fact that the oil consumption of car engines often increases rather rapidly with age. Some improvement in this respect is called for. Compression rings have a tendency to collapse at a certain definite speed, beyond which the blow-by increases rapidly, and as excessive blow-by prevents proper lubrication and is very destructive to bearing surfaces, efforts will no doubt be made to further raise the collapsing speed of the rings.

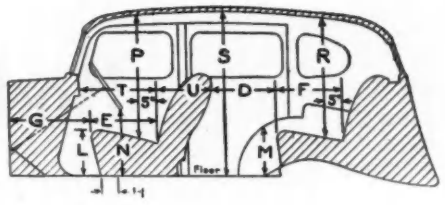


Body and Equipment

CAR MAKE AND MODEL	F. O. B. Price—(footnote)	Number of Passengers	Wheelbase—Inches	Shipping Weight	Number of Doors	Gear Ratio	Tire Size—Inches	Speedometer—Make	Gasoline Gage Make and Type	Thermometer—Make	Car Lock		Safety Glass			Windshield Cleaner Make and Type	Bumper—Make	Built-In Compartment for Trunk	Wired for Radio			Shock Absorbers	Standard Wheels		Body—Make
											Make	Type	Make	Location	Extra Cost Installed Throughout				Antenna Material	Antenna Location	Lead-In—Location	Make	One or Two-Way Type	Make	Type	
PACKARD—Continued																										
Conv. Coupe	1060	2-4	120	3485	2	4.09	7.00/16	AC	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	LP	Delco	2	MW	SD	Own
Tour. Sedan	1060	5	120	3520	4	4.09	7.00/16	AC	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Delco	2	MW	SD	Own
Conv. Sedan	1355	5	120	3630	4	4.09	7.00/16	AC	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Delco	2	MW	SD	Own
Model 1500																										
Tour. Sedan	2335	5	127	4530	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Model 1501																										
Coupe	2420	2-4	134	4585	2	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	RP	Delco	2	MW	SD	Own
Coupe	2510	5	134	4595	2	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Club Sedan	2530	5	134	4600	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Tour. Sedan	2535	5	134	4670	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rr	RP	Delco	2	MW	SD	Own
Conv. Coupe	2680	2-4	134	4580	2	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	RP	Delco	2	MW	SD	Own
Victoria	3150	5	134	4650	2	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	RP	Delco	2	MW	SD	Own
Formal Sedan	3235	5	134	4795	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Cabriolet	4850	7	134	4695	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Model 1502																										
Tour. Sedan	2705	7	139	4700	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Tour. Limousine	2840	7	139	4815	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Conv. Sedan	3350	5	139	4945	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Town Car	4990	7	139	5360	4	4.69	7.50/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Model 1506																										
Tour. Sedan	3490	5	132	5335	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Model 1507																										
Coupe	3420	2-4	139	5255	2	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	RP	Delco	2	MW	SD	Own
Conv. Coupe	3450	2-4	139	5255	2	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	RP	Delco	2	MW	SD	Own
Tour. Sedan	3560	5	139	5525	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Coupe	3590	5	139	5415	2	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Club Sedan	3660	5	139	5520	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Formal Sedan	4260	5	139	5550	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Victoria	4490	5	139	5345	2	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	No	Sc	Rf	RP	Delco	2	MW	SD	Own
Cabriolet	5700	7	139	5740	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Model 1508																										
Touring Sedan	3885	7	144	5600	4	4.41	8.25/16	Ste	AC-E	AC-	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Tour. Limousine	4085	7	144	5660	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Conv. Sedan	4650	5	144	5680	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
Town Car	5900	7	144	5790	4	4.41	8.25/16	Ste	AC-E	AC	Delco	I	LOF	TO	No	Tri-V	Eaton	Yes	Sc	Rf	RP	Delco	2	MW	SD	Own
PIERCE-ARROW																										
Model 1701																										
Coupe	3195	3-5	139	5645	2	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Sedan	3195	5	139	5675	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Conv. Roadster	3295	3-5	139	5590	2	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Club Sedan	3295	5	139	5600	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Club Berline	3445	5	139	....	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Formal Sedan	3445	5	139	....	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Sedan	3500	7	144	5820	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rr	LP	Houde	2	KH	Wi	Own
Enc. Dr. Limousine	3650	7	144	5860	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Conv. Sedan	4100	5	144	....	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Brunn Town Brougham	5295	7	144	5840	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Model 1702-12																										
Coupe	3695	4	139	5855	2	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Sedan	3695	5	139	5920	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Conv. Roadster	3795	4	139	5800	2	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Club Sedan	3795	5	139	5850	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Club Berline	3945	5	139	....	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Formal Sedan	3945	5	139	....	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Sedan	4000	7	144	6065	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Encl. Dr. Limousine	4150	7	144	6105	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Conv. Sedan	4600	5	144	5921	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Brunn Town Brougham	5795	7	144	6085	4	4.58	7.00/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Model 1703-12																										
Sedan	4795	7	147	6125	4	4.58	7.50/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
Encl. Dr. Limousine	4995	7	147	6145	4	4.58	7.50/17	Mot	Mot-E	Mot	YT	I	PPG	TO	No	Tri-V	Eaton	Yes	Sc	Rf	LP	Houde	2	KH	Wi	Own
PLYMOUTH																										
Model P3																										
Coupe	510	2	112	2700	2	3.90	5.50/16	S-M	Mot-E	Mot	YT	I	PPG	W	....	Tri-V	Var	No	No	No	No	Delco	2	MW	SD	Own
Sedan	550	5	112	2770	2	3.90	5.50/16	S-M	Mot-E	Mot	YT	I	PPG	W	....	Tri-V	Var	....	No	No	No	Delco	2	MW	SD	Own
Sedan	595	5	112	2770	4	3.90	5.50/16	S-M	Mot-E	Mot	YT	I	PPG	W	....	Tri-V	Var	....	No	No	No	Delco	2	MW	SD	Own
Model P4																										
Coupe	575	2	112	2765	2	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	No	No	No	No	Delco	2	MW	SD	Own
Coupe	625	2-4	112	2810	2	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	No	No	No	No	Delco	2	MW	SD	Own
Conv. Coupe	745	2-4	112	2920	2	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	No	No	No	No	Delco	2	MW	SD	Own
Sedan	640	5	112	2825	2	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	LS	No	No	No	Delco	2	MW	SD	Own
Tour. Sedan	650	5	112	2840	2	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	Yes	No	No	No	Delco	2	MW	SD	Own
Sedan	670	5	112	2840	4	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	LS	No	No	No	Delco	2	MW	SD	Own
Tour. Sedan	680	5	112	2840	4	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	Yes	No	No	No	Delco	2	MW	SD	Own
Sedan	915	7	132	3255	4	4.10	6.00/16	S-M	Mot-E	Mot	YT	I	PPG	WV	....	Tri-V	Var	LS	No	No	No	Delco	2	MW	SD	Own

Footnote: Prices listed have not been changed to conform with new A.M.A. pricing policy.

Specifications



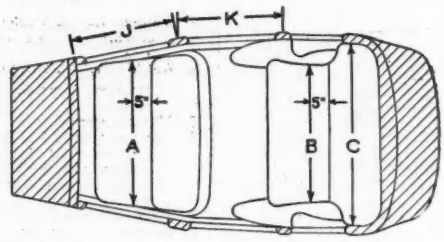
BODY DIMENSIONS

A—Width of front seat cushion, measured 5 inches from back
B—Width of rear seat cushion, measured 5 inches from back
C—Shoulder room, rear
D—Distance from back of front seat to front of rear cushion with front seat in its extreme forward position
E—Depth of front seat cushion
F—Depth of rear seat cushion
G—Distance from dash to front of front cushion with seat in its extreme forward position
H—Amount of front seat adjustment
J—Width of front door, at belt
K—Width of rear door, at belt
L—Height of front seat cushion
M—Height of rear seat cushion
N—Distance from steering wheel to floor with steering wheel in its lowest position
P—Head room at front seat measured 5 inches from back
R—Head room at rear seat, measured 5 inches from back
S—Height inside, floor to headlining
T—Distance from instrument board to back of front seat
U—Horizontal depth of front seat back

Body—Material	Top Frame Type: 1-Wire Mesh 2-Longitudinal Slats 3-Steel	Lacquer—Make	Hardware—Make	Is Steering Column Adjustable (Range in Inches)	BODY DIMENSIONS—Inches (See diagrams above) A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	Overall Height Road to Roof—Inches
S&W	1	Var	HD	No	48½	40⅞	....	....	18 3/16	15⅞	22¼	4¾	38 11/16	28½	13¼	14½	18 11/16	33	....	45½	....	14 5/16	67½
S&W	1	Var	HD	No	46⅞	48¼	53	16⅝	18	18½	22¼	4¾	34 11/16	28½	13¼	14¾	18 11/16	34 11/16	35½	48⅝	....	14¾	67½
S&W	1	Var	HD	No	46½	49¾	51	15⅝	18	19½	22¼	4¾	34 11/16	28 11/16	11 5/16	14	18 11/16	35⅛	35⅞	45½	....	14 5/16	67½
S&W	1	Var	HD	2	46	47	57	21 1/16	18 5/16	19½	23	4	33⅝	33½	13⅝	13¾	18 5/16	36	35 11/16	48 5/16	....	17 1/16	70¾
S&W	1	Var	HD	2	46	41½	....	....	18¼	18⅝	24¾	4	38⅝	....	13¼	13⅜	18 3/16	36 5/16	....	48¾	....	16⅛	70¾
S&W	1	Var	HD	2	46⅞	53¼	54¾	12½	18	19½	22¼	4¾	38⅝	....	13¼	13⅜	18 3/16	35⅞	37	49⅛	....	14 5/16	70¾
S&W	1	Var	HD	2	46	51¼	58¼	13⅞	18 5/16	19½	23	4	33⅝	33½	13⅝	13¼	18 3/16	36	36 7/16	48 5/16	....	17 1/16	70¾
S&W	1	Var	HD	2	46	47	57	26 1/16	18 5/16	19½	23	4	38⅝	35½	13⅝	13¾	18 3/16	36	35 11/16	48 11/16	....	17 1/16	70¾
S&W	1	Var	HD	2	46	41½	....	....	18	18⅝	25	4	42	....	11¾	13⅜	18¼	35¼	....	45¾	....	16⅛	70¾
S&W	1	Var	HD	2	40	46	61	12⅜	18	19⅝	23	4	42	....	11¾	11¾	18 3/16	35	38½	45	....	13	70¾
S&W	1	Var	HD	2	46	47	57	26 1/16	18¼	19½	24¾	....	38⅝	35½	13¼	13¾	18 3/16	36 5/16	35 11/16	48 11/16	....	17 1/16	70¾
S&W	1	Var	HD	2	44	46	56	29¼	18½	19¼	26⅜	....	38½	35½	13¼	13¼	18½	....	36½	49	....	....	70¾
S&W	1	Var	HD	2	46	53	57	34⅝	18 1/16	19½	23	4	38⅝	33½	13⅜	13¾	18 3/16	36	37¾	48¾	....	13¾	70¾
S&W	1	Var	HD	2	46	47	57	34⅛	18¼	19½	24¾	....	38⅝	33½	13¼	13¾	18 3/16	36 5/16	35 11/16	48¾	....	11 1/16	70¾
S&W	1	Var	HD	2	46½	48	61	17⅝	18	20	23	4	38⅝	33½	11½	12¼	18 3/16	36	37	48	....	13	70¾
S&W	1	Var	HD	2	44	46	56	34⅞	18½	19¼	26⅜	....	38½	33½	13¼	13¼	18½	....	36½	49	....	....	70¾
S&W	1	Var	HD	2	46	47	57	21 1/16	18 1/16	19½	23	4	33⅝	33½	13⅜	13¾	18 3/16	36	35 11/16	48 5/16	....	17 1/16	71
S&W	1	Var	HD	2	46	41½	....	....	18¼	18⅝	24¾	4	38⅝	....	13¼	13⅜	18 3/16	36 5/16	....	48¾	....	16⅛	71
S&W	1	Var	HD	2	46	41½	....	....	18¼	18⅝	24¾	4	38⅝	....	13¼	13⅜	18 3/16	36 5/16	....	48¾	....	16⅛	71
S&W	1	Var	HD	2	46	47	57	26 1/16	18 1/16	19½	23	4	38⅝	35½	13⅜	13¾	18 3/16	36	35 11/16	48 11/16	....	17 1/16	71
S&W	1	Var	HD	2	46⅞	53¼	54¾	12½	18	19½	22¼	4¾	38⅝	....	13¼	13¾	18 3/16	35⅞	37	49⅛	....	14 5/16	71
S&W	1	Var	HD	2	46	51¼	58¼	13⅞	18 1/16	19½	23	4	33⅝	33½	13⅜	13¼	18 3/16	36	36 7/16	48 5/16	....	17 1/16	71
S&W	1	Var	HD	2	46	47	57	26 1/16	18¼	19½	24¾	....	38⅝	35½	13¼	13¾	18 3/16	36 5/16	35 11/16	48 11/16	....	17 1/16	71
S&W	1	Var	HD	2	40	46	61	12⅜	18	19⅝	23	4	42	....	11¾	13¾	18 3/16	35	36½	45	....	13	71
S&W	1	Var	HD	2	44	46	56	29¼	18½	19¼	26⅜	....	38½	35½	13¼	13¼	18½	....	36½	49	....	....	71
S&W	1	Var	HD	2	46	53	57	34⅝	18 1/16	19½	23	4	38⅝	33½	13⅜	13¾	18 3/16	36	37¾	48¾	....	13¾	71
S&W	1	Var	HD	2	46	47	57	34⅛	18¼	19½	24¾	....	38⅝	33½	13¼	13¾	18 3/16	36 5/16	35 11/16	48¾	....	11 1/16	71
S&W	1	Var	HD	2	46½	48	61	17⅝	18	20	23	4	38⅝	33½	11½	12¼	18 3/16	36	37	48	....	13	71
S&W	1	Var	HD	2	44	46	56	34⅞	18½	19¼	26⅜	....	38½	33½	13¼	13¼	18½	....	36½	49	....	....	71
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	42	....	13¾	18¼	....	39	....	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	22	18	19½	....	4	36	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	42	....	13¾	18¼	....	37	....	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	14	18	19½	....	4	36	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	15¾	18	19½	....	4	36	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	36	29	13¾	14	....	38½	37½	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	35½	18	19½	....	4	42	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	35	18	19½	....	4	42	29	13¾	14	....	38½	37½	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	20	18	19½	....	4	42	29	13¾	14	....	38	37½	48	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	42	....	14	14	....	37	37½	50	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	42	....	13¾	18¼	....	39	....	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	22	18	19½	....	4	36	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	42	....	13¾	18¼	....	37	....	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	14	18	19½	....	4	36	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	15¾	18	19½	....	4	36	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	36	29	13¾	14	....	38½	37½	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	35½	18	19½	....	4	42	29	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	35	18	19½	....	4	42	29	13¾	14	....	38½	37½	....	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	20	18	19½	....	4	42	29	13¾	14	....	38	37½	48	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	....	18	19½	....	4	42	....	14	14	....	37	37½	50	....	....	....	....
S&W	1	....	Ter	Yes	54	50	55	37½	18	19¼	....	4	42	32	13¾	14	....	38½	37½	50½	....	....	....	....
S&W	1	....	Ter	Yes	54	49	55	37	18	19½	....	4	42	32	13⅜	14	....	38½	37½	50½	....	....	....	....
Steel	3	Dit	Jar	....	47	....	....	....	....	18½	....	21¾	4	....	....	....	14¾	....	....	38	....	....	20½	....	....
Steel	3	Dit	Jar	....	47	....	....	....	....	18½	....	21¾	§4	....	....	....	14¾	....	....	38	....	....	20½	....	....
Steel	3	Dit	Jar	....	47	....	....	....	....	18½	....	21¾	4	....	....	....	14¾	....	....	38	....	....	20½	....	....
Steel	3	Dit	Jar	....	47	....	....	....	....	18½	....	21¾	4	....	....	....	14¾	....	....	38	....	....	20½	....	....
Steel	3	Dit	Jar	....	47	....	....	....	....	18½	....	21¾	4	....	....	....	14¾	....	....	38	....	....	20½	....	....
Steel	3	Dit	Jar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Steel	3	Dit	Jar	....	47	48½	52¾	....	....	18½	19	21¾	4	....	....	....	14¾	15½	....	38	37	50	20½	....	....
Steel	3	Dit	Jar	....	47	48½	52¾	....	....	18½	19	21¾	4	....	....	....	14¾	15½	....	38	37	50	20½	....	....
Steel	3	Dit	Jar	....	47	48½	52¾	....	....	18½	19	21¾	4	34 7/16	28½	....	14¾	15½	....	38	37	50	20½	....	....
Steel	3	Dit	Jar	....	47	48½	52¾	....	....	18½	19	21¾	4	34 7/16	28½	....	14¾	15½	....	38	37	50	20½	....	....
Steel	3	Dit	Jar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

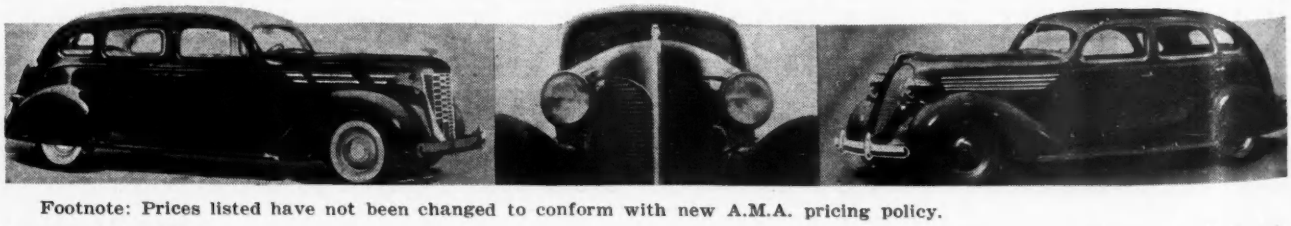
ABBREVIATIONS

†—At extra cost
§—Driver's seat only
B&S—Briggs & Stratton
Buck—Buckeye
Chi—Chicago
Del-L—Delco-Lovejoy
Doug—Douglass
Du—Du Pont
DR—Delco-Remy
E—Electric
Fer—Ferro
Fleet—Fleetwood
F-LP—Front of left pillar
Gab—Gabriel
Gord—Gordon
HD—Hancock-Dura
Houde—Houdaille
Hurd—Hurd Lock Co.
I—Ignition
IS—Ignition and Steering
Jar—W. B. Jarvis Co.
JK—Jarvis & Kesler
KH—Kelsey-Hayes
KS—King-Seeley
LOF—Libby-Owens-Ford
LP—Left Pillar
LS—Luggage Space
Mich—Michigan
Mit—Mitchell Specialty Co.
Mon—Monroe
Mot—Moto Meter Gauge & Equipment Div.
Mur—Murphy Paint & Lacquer Co.
MW—Motor Wheel
No—No or None
NaSe—Nash-Seaman
Oak—Oakes
PPG—Pittsburgh Plate Glass Co.
RB—Running Board
Rd—Rods
Rf—Roof
RM—Rinshed & Mason
RP—Right Pillar
SA—Steel—Artillery type
SAD—Steel—Artillery or Disc type
Se—Screen
SD—Steel—Disc type
Sh Pr—Shatterproof
S-M—Stewart-Warner and Moto Meter
SS—Steel Spoke
Stan—Standard Steel Spring Co.
Ste—Stewart-Warner
S&W—Steel and Wood
Ter—Ternstedt
TO—Throughout
Tri—Trico
UC—Under Car
V—Vacuum
Var—Various
W—Windshield only
Wi—Wire
WV—Windshield and Ventilators only
YT—Yale & Towne Mfg. Co.



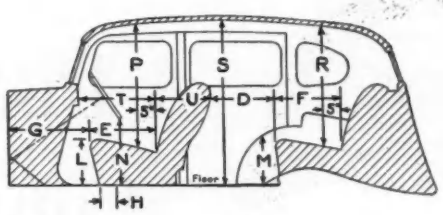
Body and Equipment

CAR MAKE AND MODEL	F. O. B. Price—(footnote)	Number of Passengers	Wheelbase—Inches	Shipping Weight	Number of Doors	Gear Ratio	Tire Size—Inches	Speedometer—Make	Gasoline Gage Make and Type	Thermometer—Make	Car Lock		Safety Glass			Windshield Cleaner Make and Type	Bumper—Make	Built-In Compartment for Trunk	Wired for Radio			Shock Absorbers		Standard Wheels		Body—Make
											Make	Type	Make	Location	Extra Cost Installed Throughout				Antenna Material	Antenna Location	Lead-In—Location	Make	One or Two-Way Type	Make	Type	
PONTIAC																										
De Luxe Six																										
Business Coupe	650	2	117	....	2	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	No	No	No	No	Del-L	2	KH	SS	Fisher
Sedan	695	5	117	....	2	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Sport Coupe	720	4	117	....	2	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	No	No	No	No	Del-L	2	KH	SS	Fisher
Tour. Sedan	720	5	117	....	2	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Sedan	745	5	117	....	4	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Tour. Sedan	770	5	117	....	4	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Cabriolet	810	4	117	....	2	4.37	6.00/16	AC	AC-E	AC	B&S	I	LOF	TO	Yes	Tri-V	Own	No	No	No	No	Del-L	2	KH	SS	Fisher
De Luxe Eight																										
Business Coupe	725	2	122	....	2	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	No	No	No	No	Del-L	2	KH	SS	Fisher
Sedan	760	5	122	....	2	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Sport Coupe	780	4	122	....	2	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	No	No	No	No	Del-L	2	KH	SS	Fisher
Tour. Sedan	785	5	122	....	2	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Sedan	805	5	122	....	4	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	SS	Fisher
Tour. Sedan	830	5	122	....	4	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	Yes	No	No	No	Del-L	2	KH	96	Fisher
Cabriolet	850	4	122	....	2	4.37	6.50/16	AC	AC-E	AC	B&S	I	LOF	TO	No	Tri-V	Own	No	No	No	No	Del-L	2	KH	SS	Fisher
STUDEBAKER																										
Dictator																										
Business Coupe	665	3	116	2965	2	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	No	Rd	UC	.....	Delco	..	Budd	SD	Own
Cust. Coupe	715	3–5	116	3005	2	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	No	Rd	UC	.....	Delco	..	Budd	SD	Own
Cust. Coupe	740	5	116	3045	2	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	No	Rd	UC	.....	Delco	..	Budd	SD	Own
St. Regis-Cruis. Sedan	745	6	116	3100	2	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	Yes	Rd	UC	.....	Delco	..	Budd	SD	Own
St. Regis-Cruis. Sedan	765	6	116	3100	2	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	Yes	Rd	UC	.....	Delco	..	Budd	SD	Own
Cust. Sedan	775	6	116	3130	4	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	LS	Rd	UC	.....	Delco	..	Budd	SD	Own
Cruis. Sedan	795	6	116	3140	4	4.55	6.00/16	Mot	Mot-E	Mot	YT	I	LOF	W	Yes	Tri-V	Stan	Yes	Rd	UC	.....	Delco	..	Budd	SD	Own
President																										
Cust. Coupe	965	3	125	3510	2	4.55	6.50/16	Mot	Mot-E	Mot	YT	I	LOF	TO	No	Tri-V	Stan	No	Rd	UC	.....	Delco	..	Budd	SD	Own
Cust. Coupe	995	3–5	125	3540	2	4.55	6.50/16	Mot	Mot-E	Mot	YT	I	LOF	TO	No	Tri-V	Stan	No	Rd	UC	.....	Delco	..	Budd	SD	Own
St. Regis-Cust. Sedan	1015	6	125	3600	2	4.55	6.50/16	Mot	Mot-E	Mot	YT	I	LOF	TO	No	Tri-V	Stan	Yes	Rd	UC	.....	Delco	..	Budd	SD	Own
St. Regis-Cust. Sedan	1035	6	125	3610	2	4.55	6.50/16	Mot	Mot-E	Mot	YT	I	LOF	TO	No	Tri-V	Stan	Yes	Rd	UC	.....	Delco	..	Budd	SD	Own
Cust. Sedan	1045	6	125	3620	4	4.55	6.50/16	Mot	Mot-E	Mot	YT	I	LOF	TO	No	Tri-V	Stan	LS	Rd	UC	.....	Delco	..	Budd	SD	Own
Cruis. Sedan	1065	6	125	3635	4	4.55	6.50/16	Mot	Mot-E	Mot	YT	I	LOF	TO	No	Tri-V	Stan	Yes	Rd	UC	.....	Delco	..	Budd	SD	Own
TERRAPLANE																										
Model 71—De Luxe																										
Business Coupe	595	3	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	No	No	No	No	Mon	2	MW	SD	Own
Coupe	605	3	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	No	No	No	No	Mon	2	MW	SD	Own
Brougham	625	6	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	LS	No	No	No	Mon	2	MW	SD	Own
Tour. Brougham	645	6	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Victoria	650	4	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Sedan	675	6	117	....	4	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	LS	No	No	No	Mon	2	MW	SD	Own
Tour. Sedan	695	6	117	....	4	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Conv. Coupe	725	3	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	LS	No	No	No	Mon	2	MW	SD	Own
Conv. Brougham	....	6	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Model 72—Supercharger																										
Coupe	660	3	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	LS	No	No	No	Mon	2	MW	SD	Own
Brougham	680	6	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	LS	No	No	No	Mon	2	MW	SD	Own
Tour. Brougham	700	6	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Victoria	700	4	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Sedan	725	6	117	....	4	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Tour. Sedan	745	6	117	....	4	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
Conv. Coupe	770	3	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	LS	No	No	No	Mon	2	MW	SD	Own
Conv. Brougham	....	6	117	....	2	4.11	6.00/16	Ste	KS-E	KS	B&S	I	PPG	W-V	Yes	Tri-V	Var	Yes	No	No	No	Mon	2	MW	SD	Own
WILLYS																										
Model 37																										
Coupe	395	2	100	2120	2	4.30	5.50/16	Ste	KS-2	No	Doug	I	Sh Pr	TO	No	Tri-V	Gord	No	No	No	No	Mon	..	KH	SD	Own
Sedan	450	5	100	2250	4	4.30	5.50/16	Ste	KS-2	No	Doug	I	Sh Pr	TO	No	Tri-V	Gord	Yes	No	No	No	Mon	..	KH	SD	Own
Model 37—De Luxe																										
Coupe	435	2	100	....	2	4.30	5.50/16	Ste	KS-2	No	Doug	I	Sh Pr	TO	No	Tri-V	Gord	No	No	No	No	Mon	..	KH	SD	Own
Sedan	490	5	100	....	4	4.30	5.50/16	Ste	KS-2	No	Doug	I	Sh Pr	TO	No	Tri-V	Gord	Yes	No	No	No	Mon	..	KH	SD	Own

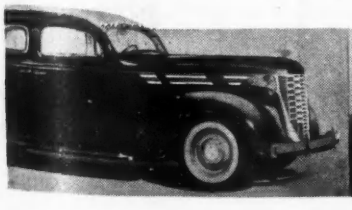
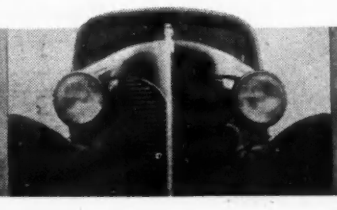
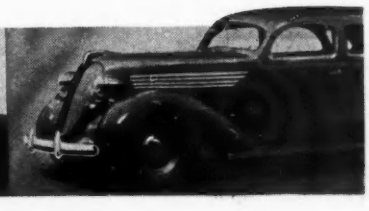


Footnote: Prices listed have not been changed to conform with new A.M.A. pricing policy.

Specifications



Body—Material	Top Frame Type 1-Wire Mesh 2-Longitudinal Slats 3-Steel	Lacquer—Make	Hardware—Make	Is Steering Column Adjustable (Range in Inches)	BODY DIMENSIONS—Inches (See diagrams above) A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	Overall Height Road to Roof—Inches
Steel	3	Du	Ter	No	52½				18		22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	66½
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	66⅞
Steel	3	Du	Ter	No	52½				18		22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	66½
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	66⅞
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	34½	27¾	13	15	20	39	37	48¾	21¼	13½	66⅞
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	34½	27¾	13	15	20	39	37	48¾	21¼	13½	66⅞
Steel	3	Du	Ter	No	52½				18		22⅝	4	44⅜		13	15	20	39	37	36	21¼	13½	64⅞
Steel	3	Du	Ter	No	52½				18		22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	66⅞
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	67¼
Steel	3	Du	Ter	No	52½				18		22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	66⅞
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	44⅜		13	15	20	39	37	48¾	21¼	13½	67¼
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	34½	27¾	13	15	20	39	37	48¾	21¼	13½	67¼
Steel	3	Du	Ter	No	52½	46¾	53¾	20¼	18	19½	22⅝	4	34½	27¾	13	15	20	39	37	48¾	21¼	13½	67¼
Steel	3	Du	Ter	No	52½				18		22⅝	4	44⅜		13	15	20	39	37	36	21¼	13½	65¼
Steel	3			1 7/16	50	36			18		23¼	4	39⅜		14⅜		20 9/16	36		48⅞	23	15	65⅞
Steel	3			1 7/16	50	36			18		23¼	4	39⅜		14⅜		20 9/16	36		48⅞	23	15	65⅞
Steel	3			1 7/16	50	36			18		23¼	4	39⅜		14⅜		20 9/16	36		48⅞	23	15	65⅞
Steel	3			1 7/16	50	48	53¼	19	18		23¼	4	41 11/16		14⅝	13	20 9/16	37	36	49⅝	23	13	67
Steel	3			1 7/16	50	48	53¼	19	18		23¼	4	41 11/16		14⅝	13	20 9/16	37	36	49⅝	23	13	67
Steel	3			1 7/16	50	48	53¾	19	18		23¼	4	35	28 13/16	14⅝	13	20 9/16	37	36	49⅝	23	13	67
Steel	3			1 7/16	50	48	53¾	19	18		23¼	4	35	28 13/16	14⅝	13	20 9/16	37	36	49⅝	23	13	67
Steel	3			¾	50	36			18	18	23¼	4	39⅜		14⅛	14⅛	20 9/16	36		48⅞	23	15	66⅛
Steel	3			¾	50	36			18	18	23¼	4	39⅜		14⅛	14⅛	20 9/16	36		48⅞	23	15	66⅛
Steel	3			¾	50	48	53¼	19	18	19	23¼	4	41 11/16		14⅝	14⅛	20 9/16	37	36	49⅝	23	13	67¼
Steel	3			¾	50	48	53¼	19	18	19	23¼	4	41 11/16		14⅝	14⅛	20 9/16	37	36	49⅝	23	13	67¼
Steel	3			¾	50	48	53¾	19	18	19	23¼	4	35	28 13/16	14⅝	14⅛	20 9/16	37	36	49⅝	23	13	67¼
Steel	3			¾	50	48	53¾	19	18	19	23¼	4	35	28 13/16	14⅝	14⅛	20 9/16	37	36	49⅝	23	13	67¼
Steel	3	Var	Var	1	55				17½		22	4	39¼		13½		19⅛	37			24⅝	13¼	69⅝
Steel	3	Var	Var	1	55				17½		22	4	39¼		13½		19⅛	37			24⅝	13¼	69⅝
Steel	3	Var	Var	1	55	48	56	17	17½	16¾	22	4	39¼		13½	13¾	19⅛	37	36½	48¾	24⅝	13¼	70½
Steel	3	Var	Var	1	55	48	56	17	17½	16¾	22	4	39¼		13½	13¾	19⅛	37	36½	48¾	24⅝	13¼	70½
Steel	3	Var	Var	1	55				17½		22	4	39¼		13½		19⅛	37			24⅝	13¼	69⅝
Steel	3	Var	Var	1	55	48		17	17½	16¾	22	4	32¼	29⅛	13½	13¾	19⅛	37	36½	48¾	24⅝	13¼	70½
Steel	3	Var	Var	1	55	48		17	17½	16¾	22	4	32¼	29⅛	13½	13¾	19⅛	37	36½	48¾	24⅝	13¼	70½
Steel		Var	Var	1	55							4	39¼				19⅛						68
Steel		Var	Var	1	55	48						4	39¼				19⅛						68⅛
Steel	3	Var	Var	1	55				17½		22	4	39¼		13½		18⅝	37			24⅝	13¼	69⅝
Steel	3	Var	Var	1	55	48	56	17	17½	16¾	22	4	39¼		13½	13¾	18⅝	37	36½	48¾	24⅝	13¼	70½
Steel	3	Var	Var	1	55	48	56	17	17½	16¾	22	4	39¼		13½	13¾	18⅝	37	36½	48¾	24⅝	13¼	70½
Steel	3	Var	Var	1	55				17½		22	4	39¼		13½		18⅝	37			24⅝	13¼	69⅝
Steel	3	Var	Var	1	55	48		17	17½	16¾	22	4	32¼	29⅛	13½	13¾	18⅝	37	36½	48¾	24⅝	13¼	70½
Steel	3	Var	Var	1	55	48		17	17½	16¾	22	4	32¼	29⅛	13½	13¾	18⅝	37	36½	49¼	24⅝	13¼	70½
Steel		Var	Var	1	55							4	39¼				18⅝						68
Steel		Var	Var	1	55	48						4	39¼				18⅝						68⅛
Steel	3	Du	JK	1	50				19		22¼	3	41½		10¼		20	37		45¼	24		64
Steel	3	Du	JK	1	50	47	50	11	19	19	22¼	3	36¾	33¼	10½	11	20	37	36	46½	24	12	65¼
Steel	3	Du	JK	1	50				19		22¼	3	41½		10¼		20	37		45¼	24		64
Steel	3	Du	JK	1	50	47	50	11	19	19	22¼	3	36¾	33¼	10½	11	20	37	36	46½	24	12	65¼

BODY DIMENSIONS

A—Width of front seat cushion, measured 5 inches from back
B—Width of rear seat cushion, measured 5 inches from back
C—Shoulder room, rear
D—Distance from back of front seat to front of rear cushion with front seat in its extreme forward position
E—Depth of front seat cushion
F—Depth of rear seat cushion
G—Distance from dash to front of front cushion with seat in its extreme forward position
H—Amount of front seat adjustment
J—Width of front door, at belt
K—Width of rear door, at belt
L—Height of front seat cushion
M—Height of rear seat cushion
N—Distance from steering wheel to floor with steering wheel in its lowest position
P—Head room at front seat, measured 5 inches from back
R—Head room at rear seat, measured 5 inches from back
S—Height inside floor to headlining
T—Distance from instrument board to back of front seat
U—Horizontal depth of front seat back

ABBREVIATIONS

†—At extra cost
§—Driver's seat only
B&S—Briggs & Stratton
Buck—Buckeye
Chi—Chicago
Del-L—Delco-Lovejoy
Doug—Douglass
Du—DuPont
DR—Delco-Remy
E—Electric
Fer—Ferro
Fleet—Fleetwood
F-LP—Front of left pillar
Gab—Gabriel
Gord—Gordon
HD—Hancock-Dura
Houde—Houdaille
Hurd—Hurd Lock Co.
I—Ignition
IS—Ignition and Steering
Jar—W. B. Jarvis Co.
JK—Jarvis & Keeler
KH—Kelsey-Hayes
KS—King-Seeley
LOF—Libby-Owens-Ford
LP—Left Pillar
LS—Luggage Space
Mich—Michigan
Mit—Mitchell Specialty Co.
Mon—Monroe
Mot—Moto Meter Gauge & Equipment Div.
Mur—Murphy Paint & Lacquer Co.
MW—Motor Wheel
No—No or None
NaSe—Nash-Seaman
Oak—Oakes
PPG—Pittsburgh Plate Glass Co.
RB—Running Board
Rd—Rods
Rf—Roof
RM—Rinshed & Mason
RP—Right Pillar
SA—Steel—Artillery type
SAD—Steel—Artillery or Disc type
Sc—Screen
SD—Steel—Disc type
Sh Pr—Shatterproof
S-M—Stewart-Warner and Moto Meter
SS—Steel Spoke
Stan—Standard Steel Spring Co.
Ste—Stewart-Warner
S&W—Steel and Wood
Ter—Ternstedt
TO—Throughout
Tri—Trico
UC—Under Car
V—Vacuum
Var—Various
W—Windshield only
Wi—Wire
WV—Windshield and Ventilators only
YT—Yale & Towne Mfg. Co.

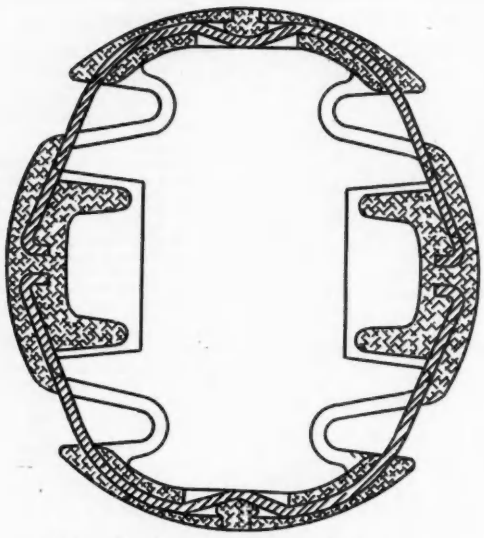


Fig. 1—Section of Ray Day piston through one of its nickel-steel bands

A Piston with Positive Constant Clearance

A "STEEL-BOUND" aluminum-alloy piston said to possess positive constant-clearance characteristics and freedom from cold slap has been announced to the industry by the Ray Day Piston Corp., Detroit, Mich. This piston construction is said to be the result of over two years of development, including dynamometer testing, and over two million miles of service in trucks and buses. It is standard equipment in two 1937 engines—a V-8 passenger car engine, and a heavy-duty marine engine.

Fig. 1 is a cross section through one of the steel bands. The pistons are cast in permanent molds, from an alloy of the Y family having a tensile strength of 53,000 lb. per sq. in. after heat treatment. Two pairs of formed steel bands are inserted in the steel mold and are held in definite locations. While the casting is being poured, small holes are formed in bosses on the skirts. After the piston has been heat-treated, plungers are pushed through these holes by a special machine, whereby the bands are given the form shown at the center of the skirt. The effect of this is to place the skirt slippers under compression by drawing them together as the steel bands are tightened. The piston is then passed on to another machine where small pellets of aluminum are pressed into the die-cast holes, and then are swaged under high pressure between the inside of the skirt and the Vee of the band, thus permanently locking the band in the form shown.

It is claimed that the piston expands at a rate approximately 65 per cent the expansion rate of cast iron, which compensates for the higher temperature attained by the skirt as compared with the cylinder wall. The piston is ground to a true cylindrical shape. With increase in temperature, the skirt expands in accordance with its average expansion rate, increasing the tension on the two steel bands and slipping freely over them. Thus the only function of the bands is that of tension elements, all other loads being carried by the piston structure.

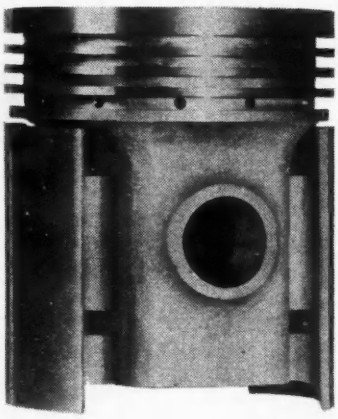


Fig. 2—The new "steel-bound" Ray Day aluminum-alloy piston

Another feature contributing to the stability of the piston is its head construction. From Fig. 2 it can be seen that the head is supported on the slipper skirt by a fillet of large radius. Moreover, about 200 deg. of arc under the head area is solidly supported by the bosses.

The alloy from which the pistons are made shows a Brinell hardness of 140-150 after heat treatment and is readily handled in the foundry. Double heat treatment is employed, combining solution and precipitation treatment. Despite its hardness, the piston elongates about 1 per cent during the heat treatment, which is taken as indicative of lack of brittleness.

According to the manufacturer, the pistons may be fitted with a clearance of 0.0005 in. per in. of cylinder bore, so that a 4-in. piston can be safely fitted with a maximum clearance of 0.002 in. Ring lands are said to require less clearance than they are usually given in split-skirt type pistons. Machining operations on this piston are said to involve no difficulty, owing to its rigidity of form and freedom from dimensional error of the permanent-mold castings.

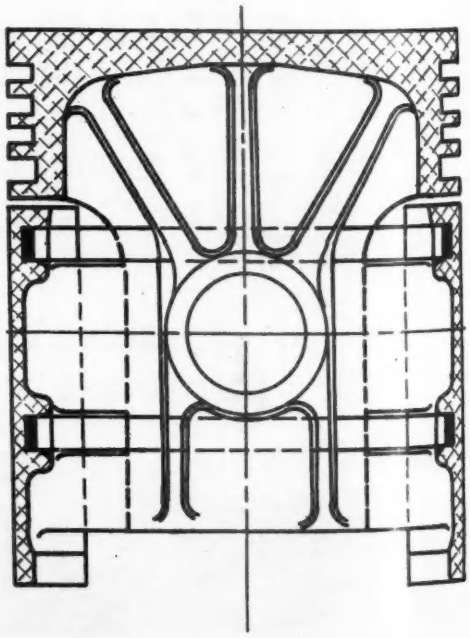
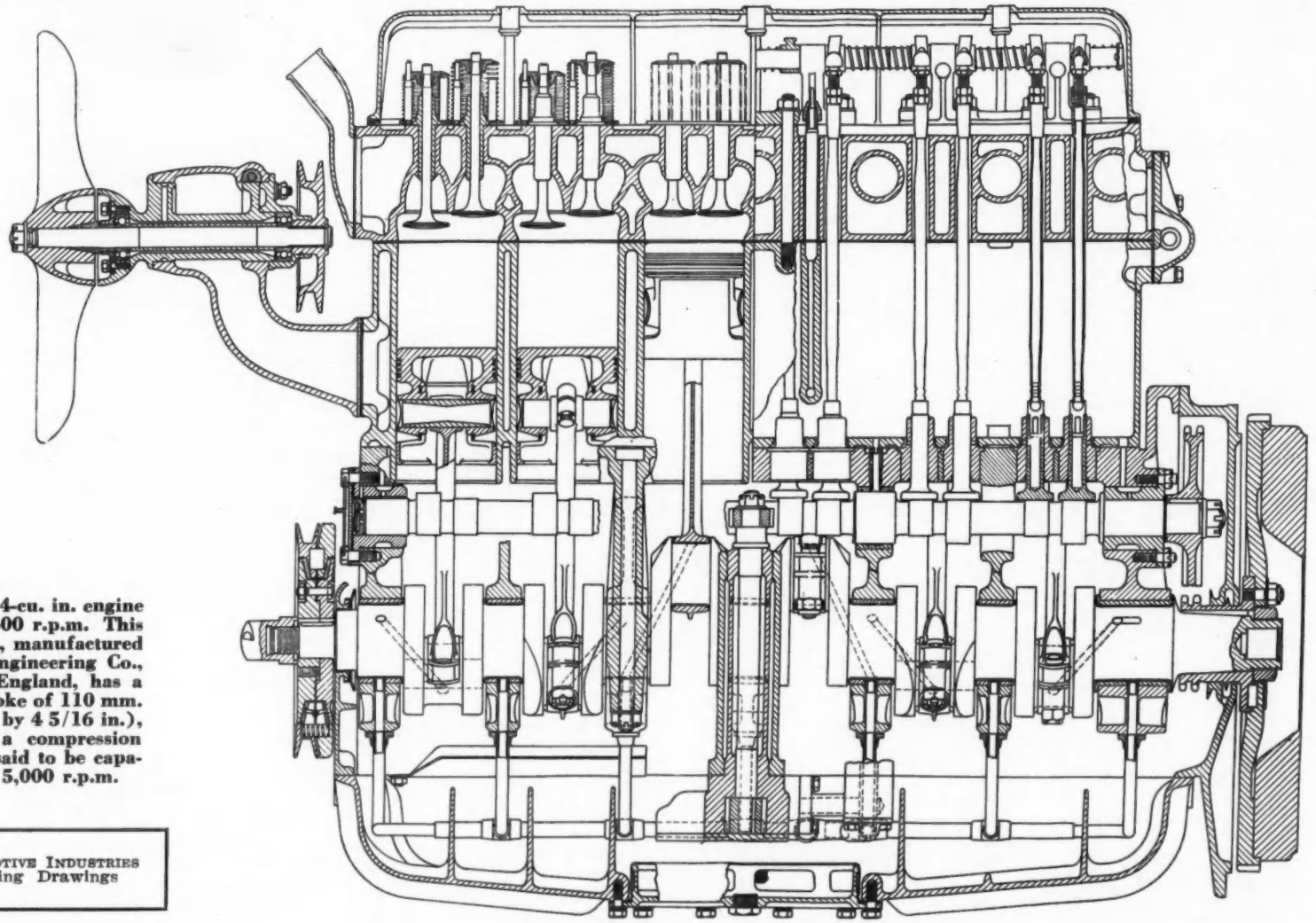


Fig. 3—Section through axis of piston

Alvis Six-Cylinder, Valve-in-Head Engine

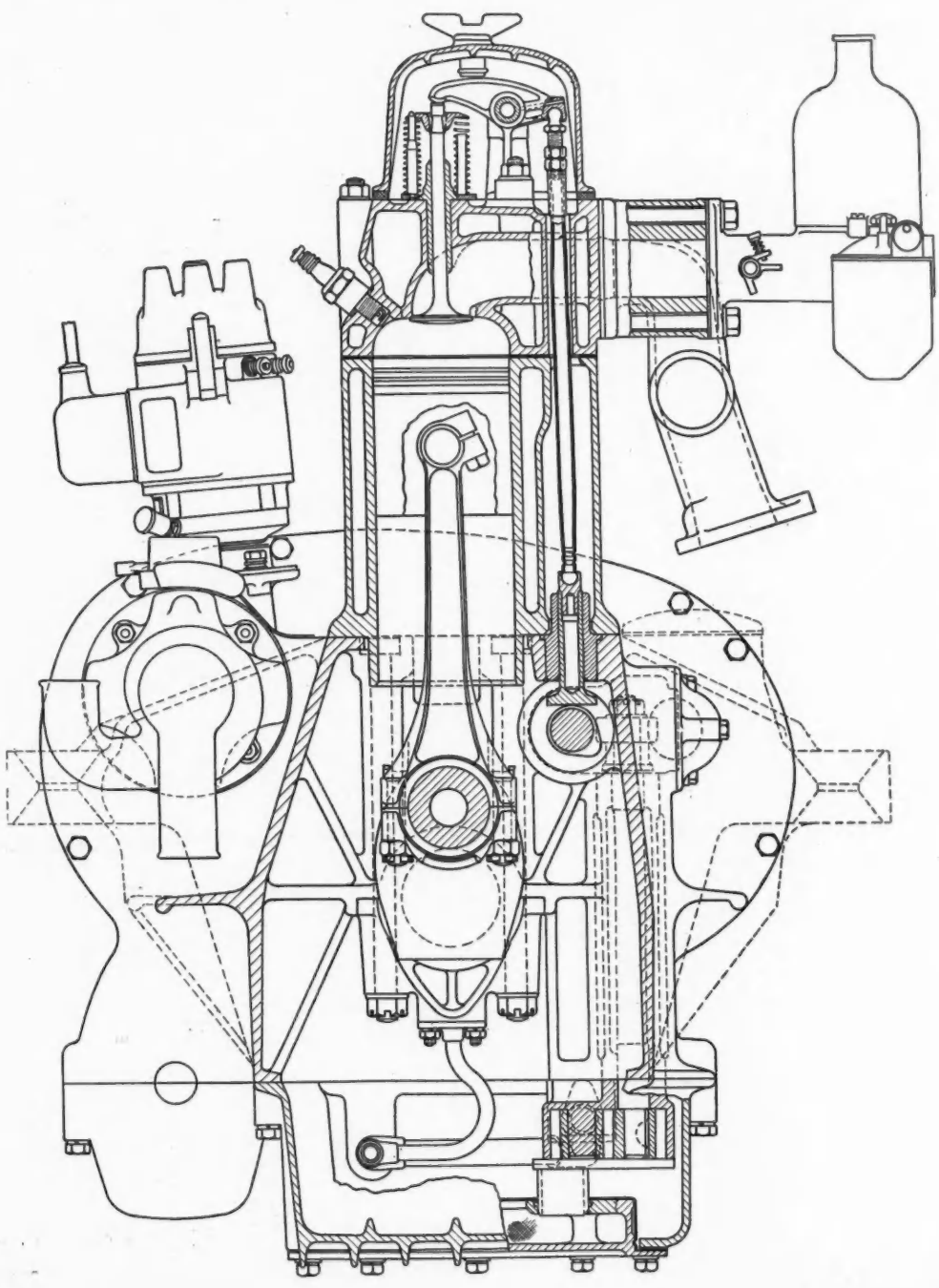


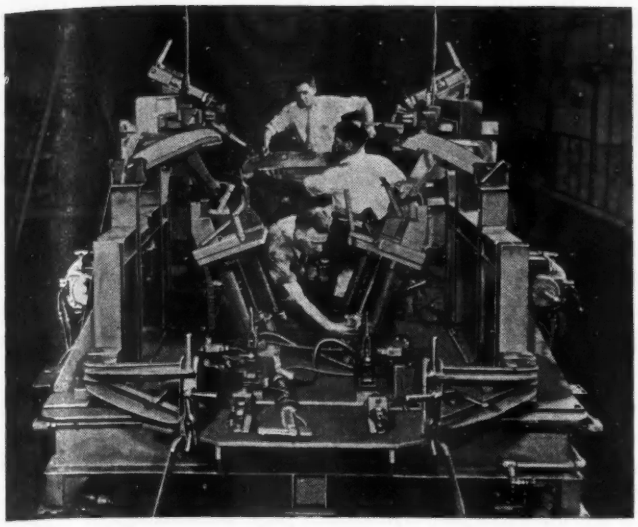
Alvis six-cylinder 214-cu. in. engine rated 102 hp. at 3600 r.p.m. This valve-in-head engine, manufactured by Alvis Car and Engineering Co., Ltd., of Coventry, England, has a bore of 83 and a stroke of 110 mm. (approximately 3¼ by 4 5/16 in.), and operates with a compression ratio of 6.35. It is said to be capable of a speed of 5,000 r.p.m.

No. 11 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

Alvis Six-Cylinder, Valve-in-Head Engine

Transverse section of Alvis engine. The overhead valves are closed by eight springs of ⅜-in. diameter each. The separate crankcase is of aluminum. Camshaft drive is by a duplex roller chain at the rear end. Bolts for the main-bearing caps extend through to the top of the crankcase. There is a Lanchester-type torsional vibration damper combined with fan-belt pulley at the forward end. A similar engine with 92-mm. (3⅝-in.) bore and 110-mm. (4 5/16-in.) stroke is rated 123 hp. at 3600 r.p.m.





A welding jig being set up for the 1937 Dodge body line

Production Lines

Enhances Finish

A little over a year ago we mentioned the commercial development of Macoid, a cellulose-nitrating coating available in a variety of colors for application on autobody hardware and other parts of the car trim. During this brief interval a number of basic improvements have been made which greatly increase the utility of the process and reduce its cost. As originally described, Macoid was applied as a dip coat and was "set" in a refrigerated chamber to retard evaporation. The formula has been radically modified so that the material may be sprayed or dipped—and what is more important, it is air-drying. These changes make it possible to supply the coating in packages so that a parts plant or manufacturing division can buy the material and spray it in their own plant. Moreover, it has been found practical to coat rubber parts with great facility so that grommets, mats, gear shift balls, and other rubber parts can be coated in color to match interior trim and at the same time provide an excellent protective surface.

Junk or Salvage

About six years ago we made quite a comprehensive study of what appeared to be a serious truck service need—the development of factory-inspired specifications on important mating elements of the motor truck. The idea was to produce statistical data giving factory clearances or limits—another set of figures indicating permissible wear insufficient to require replacement—and a third set of limits indicating imperative replacement of parts. One truck manufacturer was actually working on this project when the depression called a halt; the aircraft industry had a standard of this nature at that time. We grant you that such information would take time and money and work to develop, but isn't it worth the effort if it has any merit? We should like to throw out the suggestion that some influential fleet operators feel that such statistics are required in their business and there is the beginning of a movement afoot to get some action. Can any of our readers contribute some suggestions along this line that might give your scribe something to work on?

Good Damping

One of the Detroit metallurgists has developed a unique laboratory technique for comparing the self-damping characteristics of alloy irons and steels. It's a precise method which, incidentally, promises to yield modulus of elasticity values quickly and accurately. The results of this test work should be available some time very soon.

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99 Per Cent

Our ear to the ground reveals that there is a new alloy about to be placed on the market that should be of great interest to metallurgists. It is almost pure nickel, containing about 99 per cent nickel, the remaining 1 per cent accounting for some special alloying ingredients. The metal will develop hardness values from 300 Brinell and somewhat higher by cold-work and precipitation hardening. Its automotive applications have not yet been fully explored.

Property Life

Our insurance friends tell us of a new movement afoot in their specialty. It's termed Property Life Insurance, and is based upon experience arising from a great deal of work in Germany prior to the present regime. In brief, the attempt is made on an actuarial basis to translate depreciation and obsolescence reserves from bookkeeping entries into an insurance function where capital investment in plant and equipment is protected, renewed, or replaced by insurance coverage. This type of insurance has no counterpart nor does it conflict in any way with coverage being written on property. Here is an idea that deserves the attention of every thinking executive. In its final analysis, the development of an actuarial basis will do much to revise and revitalize our present system of estimating the useful life of productive machinery.

Tool Engineers

Several weeks ago, W. J. Cameron—he of the Ford Sunday Evening Hour—gave an interesting and inspirational talk at a banquet gathering of the A.S.T.E. The gist of it was an elevation of the art of tool engineering. And true it is, as Mr. Cameron said, that the beauty and complexity, and technical ingenuity encompassed in the modern tool far surpasses that of the product it brings into the world. It took one of the best speakers of our industry to make vocal the intrinsic worth of a branch of engineering which has not yet had its full share of credit for technical achievement.

—J. G.

MANUFACTURING MANAGEMENT METALLURGY

Hardness Test Favored

in selecting aircraft engine materials, says J. B. Johnson at Annual SAE Meeting

"AIRCRAFT Engine Materials," a paper presented at the Annual SAE meeting by J. B. Johnson, chief, materiel branch, Wright Field, was a very comprehensive treatment of the ferrous and non-ferrous materials commonly used for aircraft engine elements.

According to Mr. Johnson, the hardness test is employed more than any other mechanical test, while the Izod notched-bar test is losing its popularity as an acceptance test. It is an interesting fact that although practically all failures in service show typical fatigue fractures, a fatigue test is specified as a criterion of acceptance only in rare cases.

Sectioning of forgings and deep etching to study grain flow is quite common practice, although no universal standards have been established for this technique. At Wright Field the Materiel Division has recently adopted the Magnaflux technique of inspection for surface defects and is applying it for 100 per cent inspection of all magnetic materials from engines which have been torn down for overhauling. At present, the equipment is being operated at a current density of 3000 amps. per sq. in., which is sufficiently powerful to show up inclusions and other defects which are under the surface even to a depth of 0.007 in. Under present conditions all defects are cause for rejection, but it was brought out in the discussion that eventually it may be possible to establish standards that will differentiate between various types of defects and thus reduce the rejections. In fact one of the steel men present pointed out that inclusions are very difficult to eliminate entirely and that they are not necessarily harmful.

The author noted the wide use of aluminum and magnesium alloys and pointed out that the use of magnesium alloys for parts not subjected to high temperatures is increasing. A representative of the Aluminum Co. indicated that in future magnesium alloys will be fabricated in the form of forgings and even stampings.

Principal Engine Parts and Representative Specifications

Name of Part	Spec. No.	Hardness	Spec. No.	Hardness	Spec. No.	Hardness	Spec. No.	Hardness
Cylinder barrels	1050	225	4140	300	Nitralloy	900		
Cylinder heads	39	65	34	65				
Piston	321	100	NF-2	100	NF-3	115	39	110
Piston rings	Cast iron	B-100						
Valve, intake	Cr-Si-W	C-42	Cr-Ni-Si	C-40	Cr-Si-Mo.	C-50	71360	C-45
Valve, exhaust	Cr-Si-Mo	C-50	Cr-Ni-W-Si	C-15	Co-Cr	C-55	13.5 Cr	C-50
Valve, guide	68	175	701	160	Co-Cr	C-50	62	B-85
Valve, spring	1095	C-44	6150	C-44				
Valve, spring washer	3135	C-35	6150	C-40				
Valve, spring retainer	3250	C-50	6150	C-40				
Valve seat	68	225	NF-9	200	Cr-Ni-W-Si	C-15	701	160
Valve lock wire	1085							
Rocker arm	3140	C-30	6150	C-30	2330	C-30		
Rocker arm hub bolt	3140	C-32	6150	C-25	3312	C-60		
Rocker arm bearing	Ball		Roller					
Rocker arm cup	10115	C-62	3250	C-42	52100	C-60	6180	C-55
Push rod, tube	26		X-4130	C-35	1025			
Push rod, ball end	1015	C-62	3250	C-46	1095	C-50		
Push rod, roller	3115	C-60	3215	C-60				
Push rod, roller pin	3140	C-40	3250	C-50	6150	C-52		
Cam	3250	C-55	2515	C-60				
Camshaft	1015	C-60						
Cam bearing	64	B-75	62	B-85				
Cam drive shaft & gear	3312	C-60	3140	C-38	2515	C-55		
Crankcase, main	322	80	38	80	28	115		
Crankcase, frt.; rear; blower section	322	80	38	80	NF-5 & 6	45		
Impeller	26	115	27	100				
Impeller shaft	2515	C-60	3312	C-60	Nitralloy	900		
Impeller shaft bearing	Ball							
Crankshaft	X-3140	260	3240	280	4340	320	2515	C-60
Crankshaft counterweights	1035	160	43	140	640			
Crankshaft extension	3140	C-40	3250	C-45	2515	C-55		
Propeller hub nut	6135	250	3312	C-60	2330	C-30		
Propeller hub cone	68	210	65	160				
Rod, connecting	3140	270	4340	350	2340	340		
Pin, piston	6150	C-50	3312	C-60	3250	C-47	Nitralloy	900
Pin, knuckle	3312	C-60	3120	C-60	52100	C-60		
Pin, bushings	62	150	63	130				
Bolts, conn. rod, crankcase	3250	C-35	6150	C-35	3140	C-30		
Studs, cylinder	6150	C-26	3140	C-30				
Nuts	6150	B-95	3140	C-25	2330	C-20		
Gears, reduction; cam shaft drive; accessory drive	3250	C-45	3312	C-60	2515	C-60	Nitralloy	900
Housings, accessory drive	30	70	322	50-80	38	50-70	NF-5 & 6	45
Housings, accessory drive covers	30	70	322	50-80	35	45	38	50-70
Sump, oil; scoops, air	30	70	35	45	NF-5	45		

Hardness Values are taken from Service Parts and are Brinell (10 mm. ball—3000 kg. Load for steel and aluminum-bronze—500 kg. for other non-ferrous alloys) unless preceded by C or B for Rockwell—Cone and 1/16 ball, respectively.

In the discussion on aluminum alloys, it was indicated that the loss in physical properties of aluminum parts may be due largely to the heating cycles imposed during process operations. If heat-treatment operations are carried on under controlled limits of temperature below the critical range, it seems possible to eliminate the customary stabilizing treatment.

For protection against corrosion, aluminum alloy parts are anodized, while steel parts are cadmium-plated. Chromium plating has been found best for coating steel propeller blades and for resizing worn or undercut parts. Improvement in chromium-plating technique may lead to many other applications, such as to valve stems and piston heads.

In the table reproduced on the opposite page, the author lists the principal engine parts with representative metal specifications.

Welding Aluminum Alloys

G. O. Hoglund, Aluminum Co. of America, presented a paper entitled, "Spot and Seam Welding of Aluminum Alloys" in which he discussed the technique of resistance welding as applied to aircraft and other automotive structures. In general, the usual spot and seam welding equipment is not suitable for welding aluminum, as a much higher current density is required. Experience has shown that the machine should deliver at least 24,000 amp. at the tips for 1/16 in. stock, 33,000 amp. for ⅛ in. stock, and 42,000 amp. for 3/16 in. stock.

Proper timing control is absolutely required to produce quality welds, and the author recommends the electronic types of timers exclusively for seam welding, although mechanical timers may be used for spot welding.

So far as welding types are concerned, the author finds that water cooling to within ⅜ in. of the contact surface is absolutely essential, and that copper alloys with high electrical conductivity are required. Heat treated copper alloys are recommended for this service.

AUTOMOTIVE ABSTRACTS

Synthetic Flax (Linen) from Milk

FOR nearly forty years various investigators have attempted to produce artificial fibers from milk (casein), without, however, obtaining very encouraging results. The sanctions enforced against Italy by the League of Nations last winter and spring caused the problem to be taken up again in that country, and it is now reported that Antonio Feretti of Milan has invented a process which is being exploited by the Viscosa Company, whose works at Cesano Moderna turn out between 30 and 50 tons per day of the new product called Lanital.

Milk, skimmed in centrifuges so as to reduce the fat content to 0.10-0.15 per cent, is coagulated by means of lactic acid of fermentation, the same as in the manufacture of casein, the yield being 1 lb. of dry casein from 8 gals. of milk. It is advisable to use the precipitate directly, which on leaving the press contains about 60 per cent of water. as this eliminates losses and the cost of drying. However, the wet casein spoils rather rapidly.

The casein is dissolved in ammonia in a liquid bath. This process yields a viscous mass which is transformed into threads by the "dry-spinning" trade, the same as in the case of cellulose acetate. It is dried, treated with formol to coagulate the casein, treated in a bath of zinc salts to prevent the threads from sticking together, and may then be subjected to another drying process. It is possible to add plasticisers and also to "age" or "ripen" the material to be spun.

Lanital is said to greatly resemble flax as regards both its "feel" and its chemical composition, both of the fibers being proteins. The compositions are as follow:

	Carbon	Hydrogen	Oxygen	Nitrogen	Sulfur
Flax (percent) ..	49.25	7.57	23.66	15.86	3.66
Lanital	53.00	7.00	23.00	15.50	0.70

The low sulfur content permits of a better use of coloring materials, which fix themselves more nearly uniformly on the artificial fibers. Dyeing is thus accomplished more rapidly and injures the textile material less.

The National Economic Office at Hamburg, Germany, has issued a report of its laboratory covering an analysis of a sample of Lanital. The color was beige and the sample consisted of fibers of different length varying between 1.25 and 2 in. and between 0.0012 and 0.0014 in. in diameter. The surface of the fibers was streaky and not very smooth. Gases of combustion of the material were very alkaline. The fibers did not swell in water. Iodine imparted a brownish-yellow color. Diluted sulfuric acid did not attack it either hot or cold. A 10 per cent solution of caustic soda caused the fibers to swell about 30 per cent and the latter became fragile, particularly at high temperatures. The tensile strength of the fibers varied between 4.1 and 8.3 grams, as compared with 31-38.5 grams for flax. Its elongation before rupture is very irregular, varying between 5 and 75 per cent, compared with 62 to 82 per cent for linen. Lanital must be spun into a mixture with flax, cotton, etc.—*La Technique Moderne.*

New Cylinder Head And Barrel

RECENT modifications in the design of the Pegasus aircraft engine, product of the Bristol Aeroplane Co., include a new design of cylinder head and barrel, with a substantial increase in cooling area, sodium-cooled and stellited exhaust valves, stellited valve seats, hardened cylinder barrels, rubber-buffer mounting, alternative reduction-gear ratios and facilities for the standardization of a controllable-pitch propeller. The specific output of the engine has been increased by the use of high-octane fuel, a higher degree of supercharging, a higher compression ratio, and increased crankshaft speed. Weight has been saved mainly by the judicious use of alloy steels and magnesium castings.

The nine-cylinder engine has a bore and stroke of 5¾ by 7½ in., which makes its displacement 1753 cu. in. The normal speed of the latest Mark X engine is 2250 r.p.m. and the maximum 2600. The b.hp. for take-off at sea level at normal r.p.m. is 890/920, while the rated output at the same speed is 790/820 hp. at 3500 ft. The net weight is 1005 lb.

To permit of the higher output, the cylinder head has been redesigned. This in conjunction with the redesigned

cylinder increases the cooling area 40 per cent. The cylinder bore is of hardened alloy steel possessing good wearing qualities and thus contributing to oil economy. A thermocouple location is incorporated in the cylinder head.

The article here abstracted gives a full description of the engine, with a transverse sectional assembly drawing and a considerable number of photographs.—*The Automobile Engineer.*

Preloading of Anti-Friction Bearings

WHATEVER type of bearing is selected for the pinion shaft of the rear-axle drive, stiffness is considerably increased by "preloading." In the case of the double-row rigid bearing this is entirely the responsibility of the bearing makers, but in the case of the taper roller design it depends generally on adjustment during assembly.

To make clear the principle of preloading, consider a pinion mounted on two angular-contact ball bearings (*A* and *B*, Fig. 1). The adjusting nut may be tightened until all parts just make contact. Now suppose that it is tightened

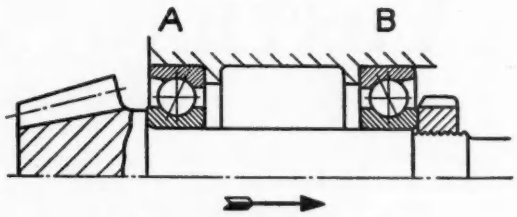


Fig. 1 — Diagram of belvel - pinion shaft mounted on two axial-contact ball bearings

further. It is obvious that the spindle will be subjected to a tensile stress, while there will be a compressive stress in the balls of both bearings. These loads will be equal and opposite and will cause a certain deformation of the balls and races. The relationship between load and deflection in the case of balls follows a law of the form

$$\delta = CP^{2/3}$$

where δ is the deformation,
P, the load, and
C, a constant.

The axial displacement of the inner ring relative to the outer will obviously be $\delta/\sin\alpha$, where α is the contact angle.

If a curve is plotted connecting load and axial displacement, it will have the form shown in Fig. 2. From this it

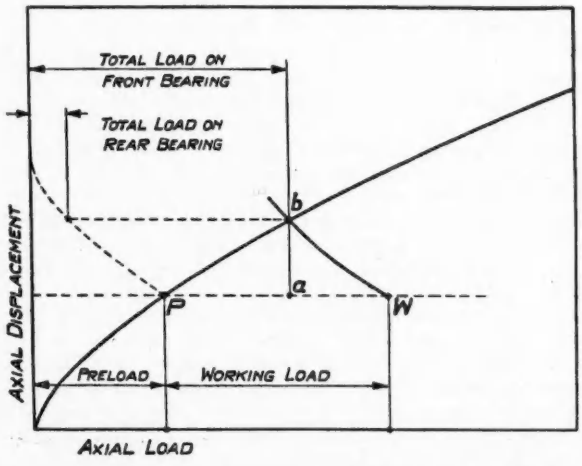


Fig. 2—Relation between axial load and axial displacement in ball bearings

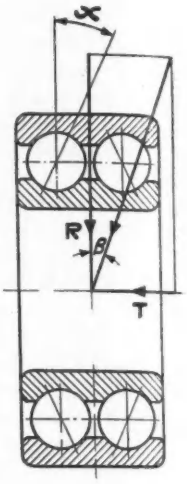


Fig. 3 — Diagram of load angle (α) and contact angle (β)

will be clear that, starting from the unloaded position, a small load will give rise to a relatively large displacement, while increments of load will cause relatively smaller increments of displacement; in other words, the stiffness increases with the load. Therefore if the steeper portion of the curve can be eliminated, there will be a marked gain in rigidity. This is precisely what happens when a bearing is "preloaded."

Referring again to the diagram, it may be supposed that, due to the tightening of the adjusting nut, each bearing is subjected to an initial or "preload" *P*. If now an external

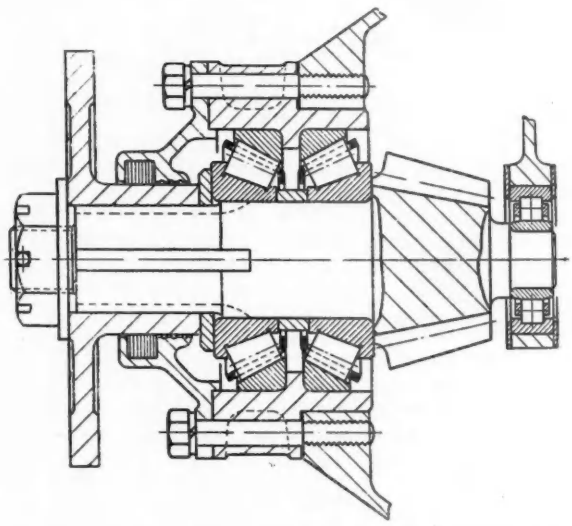


Fig. 4—One form of pinion mounting on double-taper roller bearings

or working load *W* is applied in the direction of the arrow, this will further compress the balls in bearing *A*, but at the same time will move the shaft to the right, and the result will be that bearing *B* will be relieved of part of its "preload."

If *W* is sufficiently large to cause a deflection in bearing *A* equal to the original or preload deflection, then *B* will be totally relieved of load. Until this point is reached, the working load on *A* will relieve *B* of just as much deflection as it adds to *A*. To determine these loads and deflections, the inverted deflection curve for bearing *B* must be drawn as shown dotted and transferred to the point corresponding to *W*, the working load. The intersection of this curve with the original curve gives the "preload" relief and the total load on the front bearing. The total load on the rear bearing may also be determined as shown.

The difference between the total loads on the front and

rear bearings will, of course, always be equal to the working load. The value of the deflection for the preloaded assembly is given by the line *a-b*, showing a great increase in rigidity over a non-preloaded assembly.

If a load-deflection curve is derived by the method shown, taking a number of different working loads, it will be found to be a straight line up to the point at which all preload is relieved. From there onwards it will run parallel to the ordinary load-deflection curve.

How much "preload" is desirable is a question which the author is unable to answer definitely at the present time. In practice the limit will be set by assembly difficulties due to the oversize of the balls. To take a practical example, it is possible to preload a bearing 35 x 80 x 1⅜ in. sufficiently to limit the axial movement to the Gleason figure of 0.003 in. under a thrust of 6000 lb. The outer race must, of course, be supported in a very stiff housing, otherwise distortion will occur which will increase the end movement.

Preloading is effective also in reducing radial yield. The exact distribution of the load when a double-row rigid bearing is subjected to both radial and thrust loads (Fig. 3) is rather complex, but so long as the load angle *B* is less than

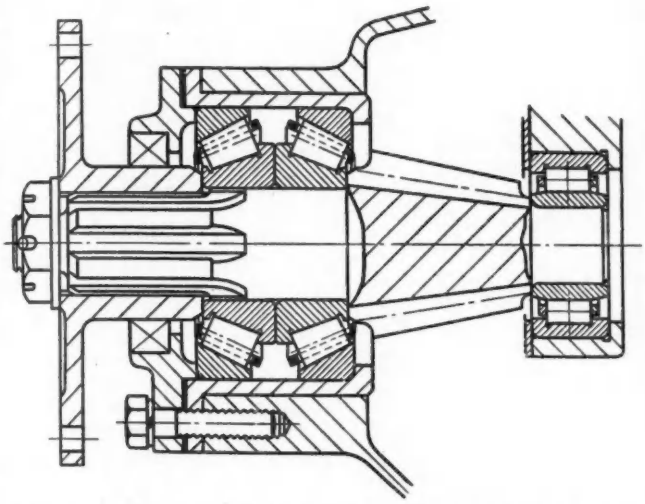


Fig. 5—Another form of pinion mounting on double taper roller bearings

the contact angle *A*, both rows of balls will be loaded. When *B* exceeds *A*, all the load will fall on one row. This is another reason why the contact angles in the case of a double-row rigid bearing are preferably arranged so the intersection of the contact lines is above the balls (further away from the bearing axis) rather than below them. It also explains why a straddle-mounted pinion with opposed taper roller bearings is better when arranged as shown in Fig. 4 than when arranged as in Fig. 5.—From a paper on "Developments in Anti-Friction Bearings," by M. J. Knaggs. *Journal of The Institution of Automobile Engineers.*

Olive Oil as Engine Lubricant

AT a recent meeting of the Engine Activity of the French Society of Automobile Engineers one of the vice-presidents of the Society, M. Prevost, reported that the Government of Tunis had issued a decree making the use of olive oil in a 25 per cent mixture with mineral oil obligatory for engine lubrication. He also stated that the French Government was considering a similar move. He considered that the compulsory use of olive oil as an engine lubricant might be of far-reaching importance to automobile owners and should be considered by the Association from both the technical and the economic viewpoints. According to M. Dintilhac, olive oil can be used for engine lubrication provided certain precautions are being taken in its production. Unless these precautions are taken the oil will contain gummy material which will cause the rings to stick in their grooves and also gum up the cylinders and pistons. M. Planiol supported the views expressed by M. Dintilhac and said that by reason of its great oiliness olive oil was an excellent engine lubricant. However, gumming troubles must be looked out for. The oil is an excellent lubricant for other purposes where gumming troubles need not be feared. It was gumming troubles which caused the Aerial Transport Company to abandon the use of castor oil as an engine lubricant. It was pointed out by one member that vegetable oils are likely to prove particularly troublesome in sleeve-valve engines such as the Knight.—*Journal of the French Society of Automobile Engineers.*

Anti-Detonants For Diesels

AN investigation of anti-detonants for Diesel-engine fuels has been made by M. Aubert, P. Clerget and R. Duchéne and was described by them in a communication to the French Academy of Sciences. Ethyl nitrate was experimented with. Records of flame propagation and of pressure variations were made simultaneously, and these led to the following observations: When gas oil alone was injected, the ignition lag was 0.003 sec. The flame photographs presented the characteristic striations of detonation, and the pressure rise was very rapid. If one of the injectors was supplied with gas oil and the other with a half-and-half mixture of gas oil and ethyl nitrate, the ignition lag became less than 0.001 second. The flame photograph from this blended fuel did not show any striations, and the pressure rise was much more gradual. The b.m.e.p. was of the same order as that obtained with gas oil. The same results were obtained when both injectors were supplied with a mixture of gas oil and ethyl nitrate containing 25 per cent of the latter.

Tests made on a single-cylinder engine with double injector gave a speed of 1800 r.p.m. with gas oil with a certain fuel charge per cycle, and with a half-and-half mixture of gas oil and ethyl nitrate, a speed of 2500 r.p.m. for the same charge.—*Comptes Rendus.*

Starting Aid for Small Diesels

THE Mercedes-Benz and Hanomag Diesel engines for private passenger cars, exhibited at last year's Berlin automobile show, employ a new Bosch unit called a "starting helper." Both of these engines are of the precombustion chamber type, in which use is normally made of electric heater plugs in the wall of the precombustion chamber. It is explained that it is considered inadvisable to entrust the relatively fragile electric plugs to the care of the private owner, and the manufacturers of the two engines mentioned therefore have cooperated with the Bosch firm in the development of this starting aid, which is intended to make the heater plugs unnecessary.

The device consists of a vertical tubular chamber mounted at the side of the engine, with a flanged connecting passage to the inlet manifold. A butterfly valve at the junction of the vertical and horizontal passages controls the admission of air from either the upper or the lower end of the vertical chamber. In the normal position of this valve the lower inlet is shut off and air enters through the air cleaner on top. For starting, the position of the butterfly valve is reversed, the upper end is shut off, and current is switched onto an electrical heating element located in the vertical chamber below the valve. The bottom of the chamber is normally closed by a light mushroom valve with flat seat, the stem of which extends down into a cup-shaped vessel containing a small amount of fuel oil. Engine suction causes the valve to lift and admit air, and at the same time a small amount of fuel is drawn in by way of a central jet in the stem of the mushroom valve. This fuel is vaporized by the electric heating element, and a warm, gaseous charge is drawn into the engine. In addition, fuel is injected by the regular fuel pump.—*The Automobile Engineer.*

New Developments Received

Descriptions of the following new products will appear in forthcoming issues of AUTOMOTIVE INDUSTRIES, space permitting. If you desire immediate detailed information on this equipment, we suggest that you consult the manufacturer.

Shear, high speed. Libert Machine Co., Green Bay, Wis.

Pipe threading and cutting machine. Landis Machine Co., Waynesboro, Pa.

Welder, arc (current-saving models). The Hobart Brothers Co., Troy, Ohio.

Filing machine, continuous-motion. Grob Brothers, West Allis, Wis.

Shaper-miller, vertical. Cochrane-Bly Co., Rochester, N. Y.

New DEVELOPMENTS

Automotive Parts, Accessories and Production Tools

Portable Press

Hannifin Develops 80 lb. Machine For High-Speed Operations

The Hannifin Mfg. Co., Chicago, has developed a high-speed, portable, hydraulic press used for application of timing gears and harmonic balancer units pressed into position on automobile engine crankshafts.

The yoke-type machine weighs approximately 80 lb. and is controlled by a push-button in the handle. The operating cycle, requiring approximately 2 sec., is completed automatically upon pressing this control button which actuates the automatic electric valve unit. The cycle includes: first, rapid advance stroke at moderate pressure; second, high pressure for the pressing stroke; third, reversal at peak pressure; fourth, rapid return to starting position.

Gear Finishing

Two-Cutter, Crossed-Axis Machine Announced by Michigan Tool Co.

A new two-cutter, crossed-axis, rotary gear finishing machine has been placed on the market by the Michigan Tool Co., Detroit.

Gear blanks to be machined are mounted between centers and are passed between two crossed-axis cutters toward the rear of the machine during the working stroke. Two cutters can be used to finish simultaneously two gears of different characteristics in a cluster, or both right and left-hand sides of a herringbone gear. This is made possible by the arrangement of the cutters which are separately adjustable as to height, position with reference to the axis of the gears, and the amount of crossed-axis setting. The crossed-axis setting results in a sliding action lengthwise of the teeth as the cutter and work are rotated with the cutter and work teeth in mesh.

Feed of the work back and forth through the cutters is by individual motor drive through reduction gears. Rapid return may be obtained by separate motor drive so that working or return stroke speeds can be varied by changing pick-off gears.

Battery Charger

General Armature Develops Auxiliary Unit For Trailers

An auxiliary battery charging device for commercial and house trailers and trucks was recently announced by the General Armature Corp., Chicago. The unit is intended to provide extra current for lights, radios, electrical accessories and other devices which operate from the storage batteries and are now generally used on cars and trailers.

The device is secured by a pivoted casting to the underside of the truck or trailer frame. It consists essentially of a special generator direct-connected to a pneumatic rubber-tired wheel which is arranged so that it can travel freely along the highway.

According to the manufacturer, the trailer battery charger will charge about 20 amp. at 22 m.p.h.

Riveter

Electric-Hydraulic Unit Announced By Hanna

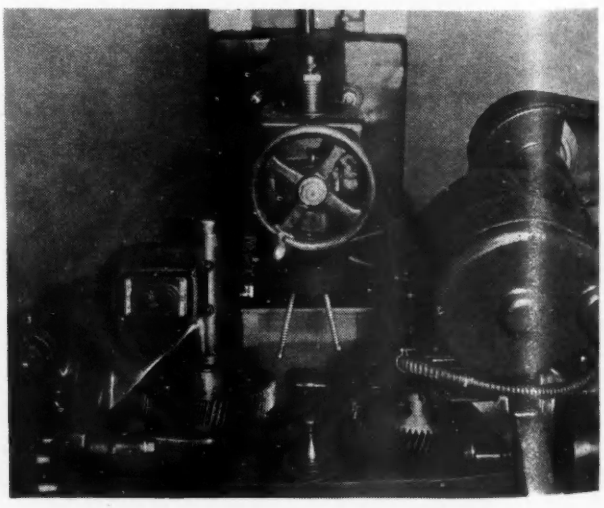
A new electric-hydraulic riveter has been announced by the Hanna Engineering Works, Chicago.

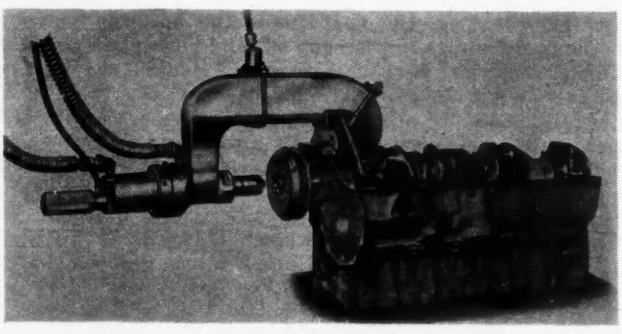
The power unit of the riveter is a combination of a motor-driven primary pump, a valve mechanism and a fluid pressure intensifier. Operation of the unit may be described as follows:

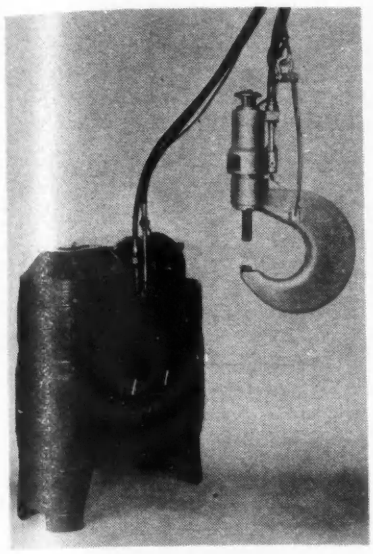
Depressing a pilot switch operates the solenoid-actuated valve permitting the fluid under primary pressure to flow directly to the riveter cylinder. At the instant the riveter ram has preformed the rivet within the capacity of the primary pressure, the intensifier automatically boosts the pressure to that which will finish the rivet. When the maximum pressure has been ex-

Right. Close-up view of Michigan Tool gear finishing machine

Below. Hannifin portable hydraulic press







Hanna electric-hydraulic riveter

erted upon the rivet the primary control valve is automatically reversed, the ram returns rapidly to the starting position, whereupon the primary control valve automatically shifts to its neutral position.

Releasing the pilot switch instantly reverses the ram movement whether it be in the primary or high-pressure stage of the riveting cycle. Likewise, depressing the pilot switch changes the return ram movement to a forward or driving stroke. A repeat cycle cannot take place. So long as the operator depresses the pilot switch the riveter will complete only one cycle. The switch must be released and depressed again to start another cycle.

The unit illustrated exerts 20 tons pressure on the dies and is capable of driving ⅜-in. rivets, cold forming a full-button head. Other units are available, both portable and stationary, for driving rivets up to 1⅛ in. hot.

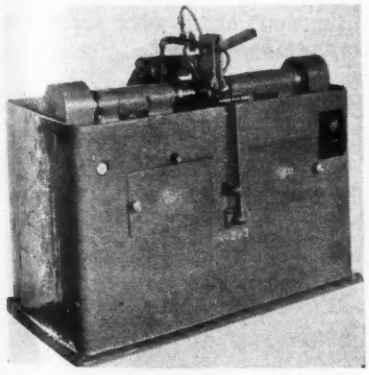
Chamfering

Grant Machine Also Handles Facing and Burring

The Grant Mfg. & Machine Co., Bridgeport, Conn., has brought out a new double-end automatic chamfering, facing and burring machine which will handle work up to 2½ in. in diameter and from ¾ in. to 6 in. long, inclusive. The machine illustrated is set up for finishing both sides of 1¼-in. nuts.

Spindles are made from chrome-nickel steel, heat-treated, and run in bronze bearings. There are fine adjustments for spindle movements, also cam adjustments for spindles.

There are change gears for both spindle speeds and feeds. The machine is equipped with silent chain drive from motor to spindles.



Grant chamfering, facing and burring machine

Straightening Press

Ram Of Hannifin Machine Delivers 75 Tons Pressure

A hydraulic press for straightening operations on airplane propellers, and similar work requiring accurate straightening, has been developed by the Hannifin Mfg. Co., Chicago.

A single lever controls the operation of the ram. When the control lever is moved in either direction, the ram will move a proportional distance and then stop, and simultaneously the op-

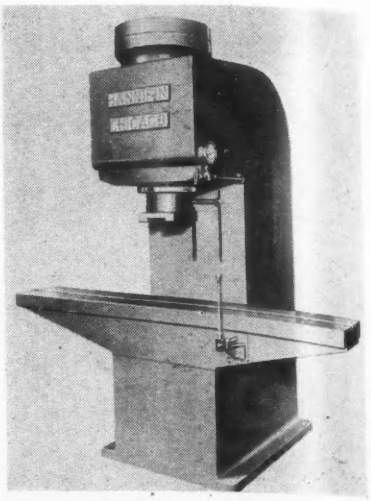
erating valve shifts to neutral. The arc of movement of the control lever is several times the ram stroke, providing for sensitive control.

The ram delivers 75 tons pressure, and may be fitted with the type of fixture required for handling the parts to be straightened. The ram stroke is 12 in. Speeds are: power stroke, 24 in. per min.; return stroke, 40 in. per min. Dimensions are: table to ram (up), 18 in.; center of ram to face of frame, 10 in.; length of table, 84 in.; floor to table, 36 in.; overall height, 100 in.

Electric Flow Meters

New Line Of Instruments Introduced By Bristol

The Bristol Co., Waterbury, Conn., has announced the addition of a complete line of electric flow meters for steam, liquids, and gases to its line of mechanical flow meters. These instruments operate on the Bristol Metameter principle of telemetering which the company has used for several years to transmit readings of pressure, liquid level, temperature, and motion from the point of measurement to a distant point where they are recorded.



Hannifin straightening press

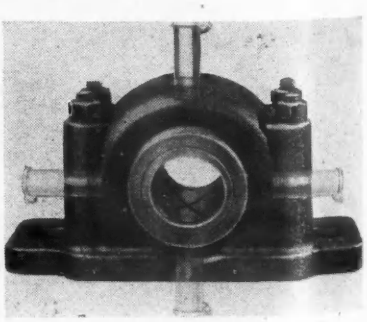
Readings are transmitted over a simple two-wire circuit, telephone circuits included, which does not enter into the calibration of the instruments. Both the transmitter and the receiver are equipped with moisture, fume, and dust-proof aluminum alloy cases. Conduit openings are provided so that the instrument may be used with modern wiring systems.

Pillow Block

Randall Universal-type Bearing Can Be Mounted In Any Position

The Randall Graphite Products Corp., Chicago, has developed a universal-type, double-reservoir, oil-return pillow block that can be mounted in any position. It is necessary only to select the mounting position needed, unscrew the oil cup, turn the ball to this position and reinsert the oil cup vertically.

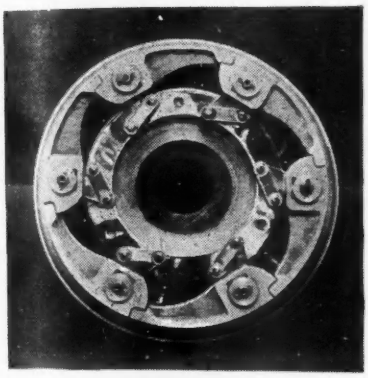
The pillow block has two large reservoirs in the spherical ball. A supply of oil is placed in the upper one which feeds the shaft through graphite feed plugs and graphite pressure-packed channels. Oil recovery grooves divert unconsumed oil into the lower wool-packed reservoir. This oil is again fed to the shaft and bearing through lower graphite feed plugs.



Randall pillow block

French Engineer Has New Brake Patent

AN internal expanding brake giving 360 deg. contact has been patented and produced by Emile Petit, French engineer. The brake shown in the illustration, and which has been designed for application to Ford automobiles, has six shoes, although this number can be varied. Each shoe is operated on at two points: at the heel by the action of a cam and at the toe by reason of the movement of the neighboring shoe. When the central ring is rotated, mechanically, hydraulically or by compressed air, all the cams connected to it move an equal distance and all the shoes move out equally from the center toward the periphery.



The pressure on the inner face of the brake drum is radial, and there is equal pressure on all parts of the brake lining; the complete surface of the drum is made use of; no local hot spots are generated by reason of point contact; elastic deformation of the drum is slight and permanent deformation is avoided. One of the practical advantages claimed for this brake is the opportunity it affords of determining the remaining thickness of the brake lining, without dismounting, by reason of the position of the external lever.

This brake has interested aircraft circles by reason of its lightness, and it can be made use of also as a centrifugal clutch.

Handbook of Chemistry and Physics

The Handbook of Chemistry and Physics, 21st edition, Chas. D. Hodgman, M.S., Editor-in-Chief. Published by The Chemical Rubber Publishing Co., Cleveland, O. $6.00.

IN the new edition of this well-known handbook several important tables appear in revised form. In the mathematical section the numerical table of former editions appears in two parts, the first giving reciprocals of numbers and circumferences and areas of circles; the second, squares, cubes and roots of numbers. All are given to at least seven significant figures.

The collection of laboratory arts and recipes has been revised and enlarged by the inclusion of material sent in by contributors. The photographic section includes new formulas and a revised table of plate and film speeds, in both the Scheiner and Weston systems. The increasing use of commercial plastics adds interest to a new collection of data on this class of materials. A revised table of isotopes brings up to date the data on this rapidly changing field. Increased convenience in the reduction of gas volumes to standard conditions will result from the use of a new table giving both the factors used in such reductions and their logarithms.

Willys Estate $2,600,000

The late John N. Willys, automobile manufacturer who died Aug. 26, 1935, left an estate of a gross value of $2,647,488.58, it was revealed in Toledo when executors filed an application in probate court to determine the amount of non-resident inheritance taxes on his real estate holdings.

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